

**Energy Savings Opportunity Survey
Energy Engineering Analysis Program (EEAP)
Fort Campbell, Kentucky**

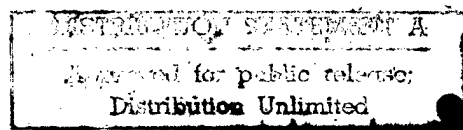
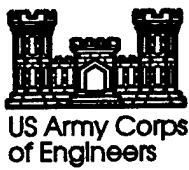
Final Report - Phase I

***Volume 3
Sections 5-15***

CONTRACT # DACA27-93-C-0096
SYSTEMS/CORP PROJECT # 93006
NOVEMBER 12, 1993

SYSTEMS_{corp}

SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION



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DTIC QUALITY INSPECTED 2

5 PROGRAMMING DOCUMENT - ECIP PROJECT 3

The ECO evaluation consisted of selecting a ground water heat pump and a system configuration to evaluate. A ground water coupled heat pump with a seasonal energy efficiency rating (SEER) of 14 was selected for evaluation. The system configuration consisted of a one for one replacement of heat pumps; and separate supply and return wells serving every two heat pumps. Bin weather data was utilized in a spreadsheet format to model the annual energy consumption of both the existing system and the proposed systems. The most significant cost for the groundwater coupled heat pump is the well systems. The project did not have an attractive simple payback when evaluated with a dedicated supply and return well for each heat pump.

This section contains the programming documentation for ECIP Project 3, installation of ground water coupled heat pumps. Included are the project development brochures, 1391 forms, life cycle cost analysis, cost estimates for the entire project, and energy calculations for each family housing area. Catalog cut sheets are included as an appendix to the document (located at the end of this section) to represent the replacement products.

facility

GROUNDWATER COUPLED HEAT PUMP

Fort Campbell, Kentucky

project coordinator for using service

Arlin Wright

functional requirements summary, PDB-1

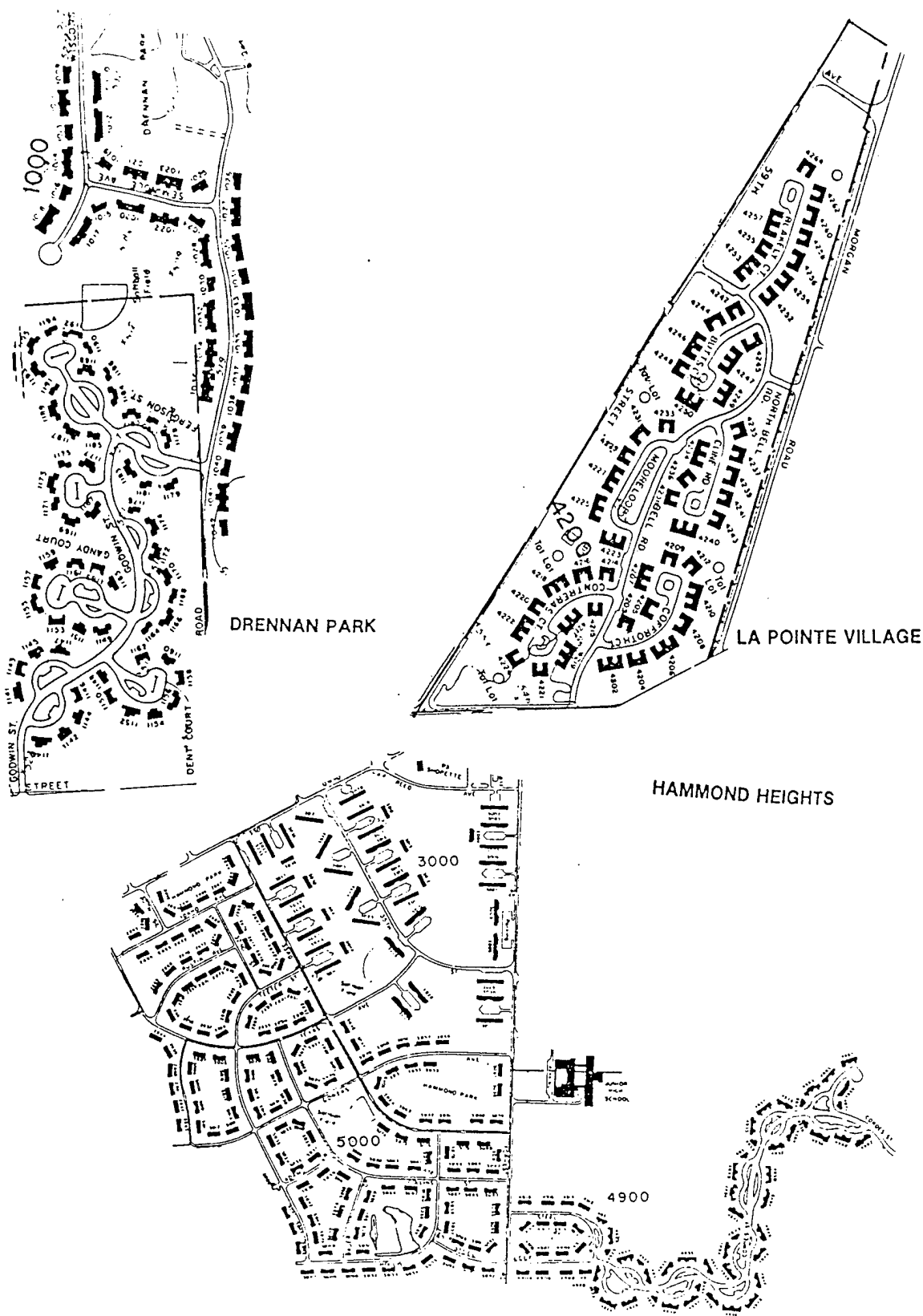
5-2

OBJECTIVE:

The objective of this project is to replace existing air to air heat pumps in 770 family housing units with groundwater coupled heat pumps. The replacement of the existing heat pump will reduce energy consumption and life cycle operating costs for the subject facilities in accordance with the Army Energy Resources Management Plan (ERMP) and Executive Order 12759.

functional requirements summary, PDB-1

5-3



facilities requirements sketch, PDB- 1/2

5-4

APPENDIX C
DOCUMENTATION CHECKLIST

A. SPECIAL CONSIDERATIONS

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
A-1	Cost estimates for each primary and supporting facility	R	D		1
A-2	Telecommunications system coordination with USACC and authorization for exceptions	NR			
A-3	Coordination with state and local governmental requirements (blind vendors, medical facilities, construction and operating permits, clearinghouse coordination, etc.)	R	A		
A-4	Assignment of airspace	NR			
A-5	Economic analysis of alternatives	R	D		
A-6	Approval for new starts	NR			
A-7	International balance of payments (IBOP) coordination with U.S. European command and NATO—overseas cost estimates and comparables (include rate of exchange used in estimates)	NR			
A-8	Impact on historic places—on site survey by authorized archeologist and coordination with state historic preservation officer and advisory council on historic preservation	NR			
A-9	Exceptions to established criteria	NR			
A-10	Coordination with various staff agencies (Provost Marshall-physical security, etc.)	R			
A-11	Identification of related or support projects (so projects can be coordinated)	R			
A-12	Required completion date	R			
Other Special Considerations (List and number items)					
1. See Appendix A					

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED — Information needed but not currently available. Enter code for information source.

COMMENT ATTACHED — Significant information summarized or explained and attached.

DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

*** BY WHOM** (Check and insert appropriate letter)

A — DFAE

B — Using Service

C — Construction Service

D — Designer

E — Other (Check Comments Attached and explain)

documentation checklist

5-6

B. SITE DEVELOPMENT

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
B-1	Consultation with the District Office to determine and evaluate flood plain hazards	NR			
B-2	Preparation, submission, and/or approval of new	NR			
(A)	General Site Plan	NR			
(B)	Annotated General Site Plan	NR			
(C)	Sketch Site Plan	NR			
(D)	Facilities Requirements Sketch	R			
B-3	Preparation of	NR			
(A)	Site Survey	NR			
(B)	Subsoil information	NR			
B-4	Approval by Department of Defense Explosive Safety Board (DDESB) for Safety Site Plan	NR			
	Other Site Development Considerations (List and number items)				
	1. See Project Development Brochure, PDB-1/2				

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documentation checklist

5-7

C. ARCHITECTURAL & STRUCTURAL

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
C-1	Reconciliation with troop housing programs and requirements	NR			
C-2	Evaluation of existing facilities (including degree of utilization)	R	D		1
C-3	Approval for removal and relocation of existing useable facilities	NR			
C-4	Evaluation of off-post community facilities	NR			
C-5	Storage and maintenance facilities (including nuclear weapons)	NR			
C-6	Coordination hospitals, medical and dental facilities with Surgeon General	NR			
C-7	Coordination of aviation facilities with FAA	NR			
C-8	Coordination air traffic control and navigational aids with USACC	NR			
C-9	Tabulation of types and numbers of aircraft	NR			
C-10	Evaluation of laboratory, research and development, and technical maintenance facilities	NR			
C-11	Coordination chapels with Chief of Chaplains	NR			
C-12	Review food service facilities by USATSA	NR			
C-13	Automated data processing system or equipment approvals—cost analysis when ADP and/or communication centers not co-located with related facilities	NR			
C-14	Coordination postal facilities with U.S. Postal Service Regional Director	NR			
C-15	Laundry and dry cleaning facilities coordination with ASD(I&L)	NR			
C-16	Tenant facilities coordination with Installation where sited	NR			
C-17	Facilities for or exposed to explosions, toxic chemicals, or ammunition—review by DDESB (See also Item B-4)	NR			
C-18	Analysis of deficiencies	R	D		1
C-19	Consideration of alternatives	R	D		2
C-20	Determination whether occupants will include physically handicapped or disabled persons	NR			
C-21	As-build drawings for alterations or additions	R	C		
C-22	Availability of Standard Design or site adaptable designs	NR			
Other Architectural & Structural (List and number items)					
1. See Supplemental Data Detailed Project Justification Paragraph D3.					
2. See Supplemental Data Detailed Project Justification Paragraph D4.					

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documentation checklist

5-8

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

ITEM

D-1	Fuel considerations and cost comparison analysis
D-2	Energy requirements appraisal (ERA)
D-3	Conformance with DOD Energy Reduction requirements
D-4	Evaluation of existing and/or proposed utility systems
	Other Mechanical and Utility Systems (List and number items)
	1. See Special Requirements, Paragraph 3 (SRP-3)

Required or Not Required	To Be Determined	Comment Attached	Document Attached
R	D		
R	D		1
R	D		
R	D		

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documentation checklist

5-9

E. ENVIRONMENTAL CONSIDERATIONS

ITEM	
E-1	Environmental impact assessment
E-2	EIA conclusions require Environmental Impact Statement
E-3	Determination of health, environmental or related hazards. Assistance to determine existence of any health, environmental or related hazard may be requested from Aberdeen Proving Ground, MD 21010, the Office of the Surgeon General, Attn: DASG-HCH (Army Environmental Hygiene Agency)
E-4	Air/water pollution permit, coordination with agencies and compliance with standards at Federal, state and local level
E-5	Corrective measures associated with Environmental Impact Statements or assessment—list separately and evaluate.
	<p>Other environmental considerations (list and number items)</p> <p>1. See Supplemental Data Detailed Project Justification Paragraph D9.</p>

Required or Not Required	To Be Determined	Comment Attached	Document Attached
R	D		1
NR			
NR			
R	A		
NR			

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documentation checklist

5-10

APPENDIX D
TECHNICAL DATA CHECKLIST

A. SPECIAL CONSIDERATIONS

ITEM

A-1	Factors of risk, restriction or unusual circumstance expected to increase costs beyond applicable area averages
A-2	Construction phasing requirements
A-3	Functional support equipment (mechanical, electrical, structural, and security) to be built in
A-4	Equipment in place and justification
A-5	Other equipment and furniture (O&MA, OPA) and costs
A-6	Special studies and tests (hazards analyses, compatibility testing, new technology testing, etc.)
A-7	Type of construction (permanent, temporary, semi-permanent)
A-8	Government furnished equipment (quantities, procurement time, availability and special handling and storage requirements). Funds used for procurement.
	Other special considerations (list and number items)

Required or Not Required	To Be Determined	Comment Attached	Document Attached
NR			
R	D		
NR			
NR			
NR			
NR			
NR			
NR			

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technical data checklist

5-12

B. SITE DEVELOPMENT

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
B-1	Construction restrictions or guidelines pertaining to site access and preferred construction routes	R	A		
(A)	Airfield clearance, explosive storage, working hours, safety, etc.	NR			
(B)	Facilities and/or functions or adjoining areas (structures, materials, impact)	R	A		
B-2	Real estate actions (acquisition, disposal, lease, right-of-way)	NR			
B-3	Demolition/relocation required (data)				
(A)	Special considerations due to explosives/radioactivity/chemical contamination/asbestos emissions/toxic gases	R	A	1	
(B)	Restrictions on disposal of demolished/relocated material including hazardous waste	NR			
B-4	Pavement types and requirements (including traffic surveys and MTMC coordination)	NR			
B-5	Landscape considerations				
(A)	Protection of existing vegetation	R	A		
(B)	Stockpile topsoil	NR			
Other Site Development (List and number items)					

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technical data checklist

5-13

C. ARCHITECTURAL & STRUCTURAL

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
C-1	Vibration-producing equipment requiring isolation	R	D		
C-2	Seismic zone and other design load criteria (typhoon, hurricane, earthquake loads, high or low loss potential)	NR			
C-3	Protective shelter evaluation and resistant design criteria (conventional/nuclear blast and radiation, chemical/biological)	NR			
C-4	Unusual foundation requirements (pier, pile, caisson, deep foundations, mat, special treatment, permafrost areas, soil bearing)	NR			
C-5	Designation and strength of units to be accommodated	NR			
C-6	Requirements and data for special design projects	NR			
C-7	Unusual floor and roof loads (safes, equipment)	NR			
C-8	Security features (arms rooms, vaults, interior secure areas)	NR			
Other Architectural & Structural (List and number items)					

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technical data checklist

5-14

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

ITEM		Required or Not Required	* To Be Determined	Comment Attached	Document Attached
D-1	Special mechanical requirements or considerations (elevator, crane, hoist, etc.)	NR			
D-2	Special peak usage periods and peak leveling techniques	NR			
D-3	Maintenance considerations (accessibility of equipment, compatibility with existing equipment)	R	D		
D-4	Plumbing—availability, general system type and characteristics (proposed and/or existing, incl. compressed air and gas)	R	D		
D-5	Heating—availability, general system type and characteristics (proposed and/or existing)	R	D		
D-6	Ventilating, air condition/refrigeration—availability, general system type and characteristics (proposed and/or existing)	R	D		
D-7	Electrical—availability, general system type and characteristics incl. airfield lighting, communication, etc. (proposed and/or existing)	NR			
D-8	Water supply/waste treatment—availability, general system type and characteristics (proposed and/or existing)	R	D		
D-9	Energy requirements/fuel conversion (sources, availability, loads, types of fuel, etc.)	R	D		
D-10	Solar energy evaluation	NR			
	Other Mechanical & Utility Systems (List and number items)				

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technical data checklist

5-15

E. ENVIRONMENTAL CONSIDERATIONS

ITEM		Required or Not Required	To Be * Determined	Comment Attached	Document Attached
E-1	Waste water treatment, air quality, and solid waste disposal criteria	R	A		
	Other Environmental Considerations (List and number items)				

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technical data checklist

5-16

F. FIRE PROTECTION

ITEM

Required or Not Required	To Be * Determined	Comment Attached	Document Attached
NR			

F-1 Special fire protection systems or features (detection and suppression equipment, hazards, etc.)
Other Fire Protection Considerations (List and number items)

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technical data checklist

5-17

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA			2. DATE 06 October 93	
3. INSTALLATION AND LOCATION Fort Campbell, Kentucky		4. PROJECT TITLE GROUND WATER COUPLED HEAT PUMPS			
5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER ECIP #3	8. PROJECT COST (\$000) \$4,600		
9. COST ESTIMATES					
ITEM		U/M	QUANTITY	UNIT COST	COST (\$000)
Primary Facility					
Ground Water Coupled Heat Pumps minimum SEER of 14.0		Lot	1	4,000,000	4,000
Subtotal					4,000
Contingency (10%)					400
Total Contract Cost					4,400
Supervision, Inspection and Overhead (5.0%)					200
Total Request					4,600
10. DESCRIPTION OF PROPOSED CONSTRUCTION The existing air to air heat pumps are inefficient. The existing heat pumps range from 1½ to 3 tons capacity. The proposed project will replace the heat pumps with groundwater coupled heat pumps with a minimum seasonal energy efficiency rating of fourteen (14). The implementation of this project will save 39,544 Mbtu/Yr of electrical energy. The first year savings is \$674,606 and the Savings to Investment Ratio (SIR) is 1.15 11. REQUIREMENT Project: The proposed heat pumps replace seven-hundred seventy (770) existing heat pumps in three Army Family Housing Areas. Requirement: The project is required to reduce the energy consumption of family housing heating and cooling and to comply with the Army Energy Resources Management Plan (ERMP) and Executive Order 12759. The proposed project will reduce annual energy consumption by 39,544 Mbtu/YR and annual energy cost by \$674,606. Current Situation: The existing heat pumps in Drennan Park, LaPointe Village and Hammond Heights are inefficient electric units.					

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 06 October 93									
3. INSTALLATION AND LOCATION Fort Campbell, Kentucky											
4. PROJECT TITLE GROUND WATER COUPLED HEAT PUMPS		5. PROJECT NUMBER ECIP #3									
<p>Impact if not provided: If the proposed project is not funded, a reduction of 39,544 Mbtu/YR cannot be achieved, and excessive amounts of energy will continue to be used. There will be no contribution to energy reduction goals established for United States Army facilities by Army Headquarters.</p> <p style="text-align: center;">_____ Colonel, USA Commanding</p> <table> <tr> <td>ESTIMATED CONSTRUCTION START:</td> <td>October 1994</td> <td>INDEX:</td> </tr> <tr> <td>ESTIMATED MIDPOINT OF CONSTRUCTION:</td> <td>April 1995</td> <td>INDEX:</td> </tr> <tr> <td>ESTIMATED CONSTRUCTION COMPLETION:</td> <td>November 1995</td> <td>INDEX:</td> </tr> </table> <p style="text-align: center;">DETAILED JUSTIFICATIONS</p> <p>D1. GENERAL</p> <p>The proposed project encompasses the replacement of heat pumps in seven-hundred seventy (770) family housing units. The project will decrease the energy consumption of the heating and cooling without reducing capacity.</p> <p>D2. ACCOMMODATIONS NOW IN USE:</p> <p>The existing heating and cooling systems are comprised of standard efficiency electric heat pumps.</p> <p>D3. ANALYSIS OF DEFICIENCY:</p> <p>Currently, seven-hundred seventy (770) family housing units are using standard efficiency heat pumps. The purpose of this project is to replace the existing heat pumps with new ground water coupled heat pumps which are much more efficient. The current deficiency results in large amounts of energy usage to maintain adequate heating and cooling.</p>			ESTIMATED CONSTRUCTION START:	October 1994	INDEX:	ESTIMATED MIDPOINT OF CONSTRUCTION:	April 1995	INDEX:	ESTIMATED CONSTRUCTION COMPLETION:	November 1995	INDEX:
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<p>D4. CONSIDERATION OF ALTERNATIVES:</p> <p>The only alternatives to proposed project are to install electric heat pumps. The disadvantages of using electric heat pumps is that less energy savings can be realized without significantly reducing the construction cost. If a less efficient unit is selected, the project would have a lower SIR.</p> <p>D5. CRITERIA FOR PROPOSED PROJECT:</p> <p>The proposed project will conform with all applicable federal and United States Army Regulations.</p> <p>D6. PROGRAM FOR RELATED EQUIPMENT:</p> <p>No equipment funded from appropriations other than MCA are required.</p> <p>D7. DISPOSAL OF PRESENT ASSETS:</p> <p>Heat pumps in seven-hundred seventy (770) family housing units will be disposed.</p> <p>D8. SURVIVAL FACILITIES:</p> <p>The proposed project is not suitable for inclusion of protective shelters.</p> <p>D9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES:</p> <p>The proposed project has been analyzed and will not adversely impact the environment. Energy savings resulting from the project will conserve natural resources.</p> <p>D10. EVALUATION OF FLOOD HAZARDS AND ENCROACHMENT ON WETLANDS:</p> <p>It has been determined that these facilities are not located in a flood plain and they do not encroach on wetlands.</p> <p>D11. ECONOMIC JUSTIFICATION:</p> <p>The proposed project qualifies under ECIP Guidelines in AR-415-15. SIR for the project if 1.15 with a simple payback of 7.17 years. See Economic Analysis, SRP-1.</p>		

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<p>D12. UTILITY AND COMMUNICATION SUPPORT:</p> <p>A. No related utility support projects are programmed. Adequate utilities are available to support the project.</p> <p>B. No telecommunication support is required.</p> <p>D13. PROTECTION OF HISTORIC PLACES AND ARCHEOLOGICAL SITES:</p> <p>The project involves the replacement of heat pumps located in existing family housing areas. Review procedures have been implemented for this project in accordance with 36 CFT 800. The review has established that there will be no effect.</p> <p>D14. PROJECT DEVELOPMENT BROCHURE (PART 1):</p> <p>A Project Development Brochure was prepared on 06 October 93 and is attached as a part of the programming documentation.</p> <p>D15. ENERGY REQUIREMENTS:</p> <p>The proposed project will reduce present energy consumption by 39,544 MBtu/Yr at the cost savings of \$674,606 per year. See Energy Requirements Appraisal (ERA) in Special Requirements, Paragraph 3 (SRP-3).</p> <p>D16. PROVISION FOR THE HANDICAPPED:</p> <p>No provisions for the handicapped will be made since the scope of the project is in no way applicable to designing for the handicapped.</p> <p>D17. REAL PROPERTY MAINTENANCE ACTIVITY (RPMA) ANALYSIS:</p> <p>A. Physical impact: There will be heat pumps removed and replaced by the same number of heat pumps. No new structures will be added.</p>		

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<p>B. Operations and Maintenance (O&M) impact:</p> <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; padding: 5px;"><u>YEAR</u></th> <th style="text-align: left; padding: 5px;"><u>O&M</u> <u>NET CHANGE (\$000)</u></th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">1994</td> <td style="padding: 5px;">0.0</td> </tr> <tr> <td style="padding: 5px;">(BOD)</td> <td style="padding: 5px;">0.0</td> </tr> <tr> <td style="padding: 5px;">1995</td> <td style="padding: 5px;">0.0</td> </tr> <tr> <td style="padding: 5px;">1996</td> <td style="padding: 5px;">0.0</td> </tr> </tbody> </table> <p>C. Backlog of Maintenance and Repair (BMAR) impact:</p> <p>There will be no net change in the number of heat pumps or in heat pump life expectancy. There will be no effect on BMAR.</p> <p>D18. COMMERCIAL ACTIVITIES:</p> <p>The proposed project is not a "New Start Expansion" as defined by DA Circular 235-1. The project has been reviewed in light of the requirements of commercial and industrial facilities. It has been determined that whereas the project does not affect commercial facilities, the requirements of DA Circular 235-1 does not apply.</p>			<u>YEAR</u>	<u>O&M</u> <u>NET CHANGE (\$000)</u>	1994	0.0	(BOD)	0.0	1995	0.0	1996	0.0
<u>YEAR</u>	<u>O&M</u> <u>NET CHANGE (\$000)</u>											
1994	0.0											
(BOD)	0.0											
1995	0.0											
1996	0.0											

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 06 October 93																																																																																			
3. INSTALLATION AND LOCATION Fort Campbell, Kentucky																																																																																					
4. PROJECT TITLE GROUND WATER COUPLED HEAT PUMPS		5. PROJECT NUMBER ECIP #3																																																																																			
<p>SPECIAL REQUIREMENTS PARAGRAPH 1 (SRP-1):</p> <p>Life Cycle Cost Analysis Project Title: Ground Water Coupled Heat Pumps Fiscal Year: 1994 Analysis Date 10/06/93 Economic Life: Twenty (20) Years</p> <p>1. INVESTMENT</p> <table style="width: 100%;"> <tr><td style="width: 80%;">A. CONSTRUCTION COST</td><td style="text-align: right;">\$4,397,946</td></tr> <tr><td>B. SIOH</td><td style="text-align: right;">\$219,897</td></tr> <tr><td>C. DESIGN COST</td><td style="text-align: right;">\$219,897</td></tr> <tr><td>D. ENERGY CREDIT CALC</td><td style="text-align: right;">-0-</td></tr> <tr><td>E. SALVAGE VALUE</td><td style="text-align: right;">-0-</td></tr> <tr><td>F. TOTAL INVESTMENT</td><td style="text-align: right;">\$4,837,740</td></tr> </table> <p>2. ENERGY SAVINGS ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS</p> <table style="width: 100%;"> <thead> <tr> <th style="text-align: left;">FUEL</th> <th style="text-align: center;">COST \$Mbtu (1)</th> <th style="text-align: center;">SAVINGS MBtu/YR(2)</th> <th style="text-align: center;">ANNUAL \$ SAVINGS(3)</th> <th style="text-align: center;">DISCOUNT FACTOR(4)</th> <th style="text-align: center;">DISCOUNTED SAVINGS(5)</th> </tr> </thead> <tbody> <tr><td>A. ELECT</td><td style="text-align: center;">6.18</td><td style="text-align: center;">39,544</td><td style="text-align: center;">244,382</td><td style="text-align: center;">8.39</td><td style="text-align: center;">2,050,364</td></tr> <tr><td>B. DIST</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>C. RESID</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>D. NG</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>E. DEMAND SAVINGS</td><td></td><td></td><td style="text-align: center;">294,184</td><td style="text-align: center;">8.11</td><td style="text-align: center;">2,385,832</td></tr> <tr><td>F. TOTAL</td><td></td><td style="text-align: center;">3,9544</td><td style="text-align: center;">538,566</td><td></td><td style="text-align: center;">4,436,197</td></tr> </tbody> </table> <p>3. NON-ENERGY SAVINGS</p> <p>A. ANNUAL RECURRING</p> <table style="width: 100%;"> <tr><td style="width: 40%;">(1)DISCOUNT FACTOR</td><td style="text-align: center;">8.11</td></tr> <tr><td>(2)DISCOUNTED SAVINGS</td><td></td></tr> </table> <p>B. NON-RECURRING SAVINGS</p> <table style="width: 100%;"> <thead> <tr> <th style="text-align: left;">ITEM</th> <th style="text-align: center;">SAVINGS(+) COST(-)(1)</th> <th style="text-align: center;">YEAR OF OCCURRENCE(2)</th> <th style="text-align: center;">DISCOUNT FACTOR</th> <th style="text-align: center;">DISCOUNTED SAVINGS(+) COST (-)(4)</th> </tr> </thead> <tbody> <tr><td>a. Replace Heat Pumps</td><td style="text-align: center;">1,360,400</td><td style="text-align: center;">5</td><td style="text-align: center;">0.82</td><td style="text-align: center;">1,115,528</td></tr> <tr><td>b.</td><td></td><td></td><td></td><td></td></tr> <tr><td>c.</td><td></td><td></td><td></td><td></td></tr> <tr><td>d. Total</td><td></td><td></td><td></td><td></td></tr> </tbody> </table> <p>C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+)/COST(-) 1,115,528</p>			A. CONSTRUCTION COST	\$4,397,946	B. SIOH	\$219,897	C. DESIGN COST	\$219,897	D. ENERGY CREDIT CALC	-0-	E. SALVAGE VALUE	-0-	F. TOTAL INVESTMENT	\$4,837,740	FUEL	COST \$Mbtu (1)	SAVINGS MBtu/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)	A. ELECT	6.18	39,544	244,382	8.39	2,050,364	B. DIST						C. RESID						D. NG						E. DEMAND SAVINGS			294,184	8.11	2,385,832	F. TOTAL		3,9544	538,566		4,436,197	(1)DISCOUNT FACTOR	8.11	(2)DISCOUNTED SAVINGS		ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCURRENCE(2)	DISCOUNT FACTOR	DISCOUNTED SAVINGS(+) COST (-)(4)	a. Replace Heat Pumps	1,360,400	5	0.82	1,115,528	b.					c.					d. Total				
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3. INSTALLATION AND LOCATION Fort Campbell, Kentucky									
4. PROJECT TITLE GROUND WATER COUPLED HEAT PUMPS		5. PROJECT NUMBER ECIP #3							
<p>SPECIAL REQUIREMENTS PARAGRAPH 1 (SRP-1) (continued)</p> <p>D. PROJECT NON ENERGY QUALIFICATION TEST (1) 25% NON ENERGY CALC</p> <table> <tr> <td>4. FIRST YEAR DOLLAR SAVINGS</td> <td>\$674,606</td> </tr> <tr> <td>5. TOTAL NET DISCOUNTED SAVINGS</td> <td>\$5,551,725</td> </tr> <tr> <td>6. DISCOUNTED SAVINGS RATIO</td> <td>1.15</td> </tr> </table>				4. FIRST YEAR DOLLAR SAVINGS	\$674,606	5. TOTAL NET DISCOUNTED SAVINGS	\$5,551,725	6. DISCOUNTED SAVINGS RATIO	1.15
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1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 06 October 93
3. INSTALLATION AND LOCATION Fort Campbell, Kentucky		
4. PROJECT TITLE GROUND WATER COUPLED HEAT PUMPS		5. PROJECT NUMBER ECIP #3
<p>SPECIAL REQUIREMENTS PARAGRAPH 3 (SRP-3)</p> <p>Energy Requirements Appraisal (ERA)</p> <p>1. Project Description: Replace existing heat pumps with more efficient heat pumps without reducing the heating and cooling capacities.</p> <p>2. Estimated Energy Consumption: The buildings are currently conditioned by standard efficiency heat pumps. The existing heat pumps consume 61,513 Mbtu/YR of energy. Replacing the existing heat pumps with high efficiency units will result in 39,544 Mbtu/YR of electrical energy savings, a sixty-four percent (64%) reduction in current energy consumption.</p> <p>3. Energy Sources: No new energy sources are required for the proposed project. The use of solar energy for this project is impractical.</p> <p>4. Energy Use Impacts: The proposed project will substantially reduce the consumption of electricity for heating and cooling. The burden on the existing base distribution system will be lessened.</p> <p>5. Energy Conservation: The proposed project will reduce annual energy consumption by 39,544 Mbtu/YR with annual energy cost savings of \$674,606. The project complies with Army Resources Management Plan (ERMP) and Executive Order 12759.</p> <p>6. Energy Alternatives: The proposed project represents the greatest possible reduction in energy consumption sixty-four percent (64%), without reducing the current heating and cooling capacities. The current levels do not exceed the levels recommended by ASHRAE.</p> <p>7. Energy Effects: The proposed project provides positive environmental effects. It reduces the current energy consumption by sixty-four percent (64%), effectively reducing the consumption of non-renewable fuel sources. The degrading of environmental standards would not make more efficient energy sources available.</p> <p>8. Basis of Approval: Total energy requirements and alternative fuel sources have been considered and included in this appraisal or discarded as applicable.</p>		

ENERGY SAVINGS OPPORTUNITY SURVEY **FORT CAMPBELL, KENTUCKY** **ECO-2 PROJECT SUMMARY**

AREA NAME	BASELINE ENERGY (MBTU)	ECO ENERGY (MBTU)	ENERGY SAVINGS (MBTU)	1ST YEAR SAVINGS	INVESTMENT COSTS	SPB (YR)	SIR
DRENNAN PARK	21,969	7,846	14,123	N.A.	N.A.	N.A.	N.A.
LAPORTE VILLAGE	13,181	4,707	8,474	N.A.	N.A.	N.A.	N.A.
HAMMOND HEIGHTS	26,363	9,416	16,947	N.A.	N.A.	N.A.	N.A.
TOTALS	61,513	21,969	39,544	\$606,586	\$4,837,740	7.17	1.15

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: HPECO21

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.072

INSTALLATION & LOCATION: FT CAMPBELL REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: 002 GROUND WATER HEAT PUMPS

FISCAL YEAR 1994 DISCRETE PORTION NAME: HEAT PUMPS

ANALYSIS DATE: 10-07-93 ECONOMIC LIFE 10 YEARS PREPARED BY: KEITH DERRING

1. INVESTMENT

A. CONSTRUCTION COST	\$	4397946.	
B. SIOH	\$	219897.	
C. DESIGN COST	\$	219897.	
D. TOTAL COST (1A+1B+1C)	\$	4837740.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		4837740.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 6.18	39544.	\$ 244382.	8.39	\$ 2050364.
B. DIST	\$ 4.98	0.	\$ 0.	9.48	\$ 0.
C. RESID	\$.00	0.	\$ 0.	10.81	\$ 0.
D. NAT G	\$ 4.00	0.	\$ 0.	10.01	\$ 0.
E. COAL	\$.00	0.	\$ 0.	8.97	\$ 0.
F. PPG	\$.00	0.	\$ 0.	8.11	\$ 0.
M. DEMAND SAVINGS			\$ 294184.	8.11	\$ 2385832.
N. TOTAL		39544.	\$ 538566.		\$ 4436197.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	0.
(1) DISCOUNT FACTOR (TABLE A)	8.11		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REPLACE	\$1360400.	5	.82	1115528.
d. TOTAL	\$1360400.			1115528.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FT CAMPBELL REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 002 GROUND WATER HEAT PUMPS
FISCAL YEAR 1994 DISCRETE PORTION NAME: HEAT PUMPS
ANALYSIS DATE: 10-07-93 ECONOMIC LIFE 10 YEARS PREPARED BY: KEITH DERRING

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 1115528.
4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$ \$ 674606.
5. SIMPLE PAYBACK PERIOD (1G/4) 7.17 YEARS
6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 5551725.
7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 1.15
(IF < 1 PROJECT DOES NOT QUALIFY)
8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 5.44 %

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 2: GROUND WATER-COUPLED HEAT PUMP

01 SEPTEMBER 1993

LOCATION: DRENNEN PARK (DUPLEX)
NO. QUARTERS: 273
PAGE 1 OF 2

EXISTING HEAT PUMP ANALYSIS-BASELINE ENERGY CONSUMPTION

BIN	ANNUAL HOURLY OCCURRENCES	FULL LOAD BTU/HR	% FULL LOAD	EER (BTUH/WATT)	ANNUAL ENERGY CONSUMPTION (KWH/YR)
100/104	2	30000	100	5	12.0
95/99	25	30000	100	5	150.0
90/94	111	30000	100	5	666.0
85/89	352	30000	83	5	1753.0
80/84	540	30000	67	5	2170.8
75/79	724	30000	50	5	2172.0
70/74	980	30000	33	5	1840.4
65/69	888	30000	17	5	903.7
60/64	763	30000	0	5	0.0
55/59	668	30000	12	5	481.0
50/54	628	30000	25	5	942.0
45/49	583	30000	37	5	1294.3
40/44	608	30000	50	5	1824.0
35/39	564	30000	62	5	2098.1
30/34	538	30000	75	5	2421.0
25/29	358	30000	87	5	1868.8
20/24	212	30000	100	5	1272.0

ENERGY CONSUMPTION 21969 MBTU COST \$464

$30,000 \text{ BTU/hr} \times \frac{1 \text{ kWh}}{3412 \text{ BTU}} = 8.79 \text{ kWh/hr}$
 $8.79 \text{ kWh/hr} \times 12 \text{ hrs} = 105.48 \text{ kWh/day}$

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 2: GROUND WATER-COUPLED HEAT PUMP

01 SEPTEMBER 1993

LOCATION: DRENNEN PARK (DUPLICATE)
NO. QUARTERS: 273
PAGE 2 OF 2

GROUND WATER-COUPLED HEAT PUMP ANALYSIS-PROPOSED ENERGY USAGE

BIN	ANNUAL HOURLY OCCURRENCES	FULL LOAD BTU/HR	% FULL LOAD	EER (BTU/H/WATT)	ANNUAL ENERGY CONSUMPTION (KWH/YR)
100/104	2	30000	100	14	4.3
95/99	25	30000	100	14	53.6
90/84	111	30000	100	14	237.9
85/89	352	30000	83	14	626.1
80/84	540	30000	67	14	775.3
75/79	724	30000	50	14	775.7
70/74	980	30000	33	14	883.0
65/69	886	30000	17	14	322.8
60/64	763	30000	0	14	0.0
55/59	668	30000	12	14	171.8
50/54	828	30000	25	14	336.4
45/49	583	30000	37	14	462.2
40/44	608	30000	50	14	651.4
35/39	564	30000	62	14	749.3
30/34	538	30000	75	14	864.6
25/29	358	30000	87	14	667.4
20/24	212	30000	100	14	454.3

ENERGY CONSUMPTION 7846 MBTU ENERGY COST \$166

DEMAND SAVINGS/UNIT = \$11.78/KWH/MO * KW SAVED * 12 MO/YR * 0.75(DIVERSITY FACTOR) = \$409

NET ENERGY SAVINGS 14,122.8 MBTU NET DOLLAR SAVINGS/YR \$707

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 2: GROUND WATER - COUPLED HEAT PUMP

01 SEPTEMBER 1993

LOCATION: HAMMOND HEIGHTS
NO. QUARTERS: 247
PAGE 1 OF 2

EXISTING HEAT PUMP ANALYSIS - BASELINE ENERGY CONSUMPTION

BIN	ANNUAL HOURLY OCCURRENCES	FULL LOAD BTU/HR	% FULL LOAD	EER (BTU/H/WATT)	ANNUAL ENERGY CONSUMPTION (KWH/YR)
100/104	2	36000	100	5	14.4
95/99	25	36000	100	5	180.0
90/94	111	36000	100	5	799.2
85/89	352	36000	83	5	2103.6
80/84	540	36000	67	5	2805.0
75/79	724	36000	50	5	2606.4
70/74	980	36000	33	5	2326.5
65/69	886	36000	17	5	1084.5
60/64	763	36000	0	5	0.0
55/59	668	36000	12	5	577.2
50/54	628	36000	25	5	1130.4
45/49	583	36000	37	5	1553.1
40/44	608	36000	50	5	2166.6
35/39	564	36000	62	5	2517.7
30/34	538	36000	75	5	2905.2
25/29	358	36000	87	5	2242.5
20/24	212	36000	100	5	1526.4

ENERGY CONSUMPTION 26363 MBTU COST \$557

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 2: GROUND WATER-COUPLED HEAT PUMP

01 SEPTEMBER 1983

LOCATION: HAMMOND HEIGHTS
NO. QUARTERS: 247
PAGE 2 OF 2

GROUND WATER-COUPLED HEAT PUMP ANALYSIS-PROPOSED ENERGY USAGE

BIN	ANNUAL HOURLY OCCURRENCES	FULL LOAD BTU/HR	% FULL LOAD	EER (BTU/H/WATT)	ANNUAL ENERGY CONSUMPTION (KWH/YR)
100/104	2	36000	100	14	5.1
95/99	25	36000	100	14	64.3
90/94	111	36000	100	14	265.4
85/89	352	36000	83	14	751.3
80/84	540	36000	67	14	930.3
75/79	724	36000	50	14	930.9
70/74	980	36000	33	14	831.6
65/69	886	36000	17	14	387.3
60/64	763	36000	0	14	0.0
55/59	668	36000	12	14	206.1
50/54	828	36000	25	14	403.7
45/49	583	36000	37	14	554.7
40/44	608	36000	50	14	781.7
35/39	584	36000	62	14	899.2
30/34	538	36000	75	14	1037.6
25/29	358	36000	87	14	800.9
20/24	212	36000	100	14	545.1

ENERGY CONSUMPTION

9415 MBTU

ENERGY COST

\$199

DEMAND SAVINGS/UNIT =

\$11.78/KWH/MO * KW SAVED * 12 MO/YR * 0.75/DIVERSITY FACTOR =

\$491

16947.4 MBTU

NET DOLLAR SAVINGS/YR

\$849

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 2: GROUND WATER - COUPLED HEAT PUMP
01 SEPTEMBER 1983

LOCATION: LA POINTE VILLAGE
NO. QUARTERS: 250
PAGE 1 OF 2

EXISTING HEAT PUMP ANALYSIS - BASELINE ENERGY CONSUMPTION

BIN	ANNUAL HOURLY OCCURRENCES	FULL LOAD BTU/HR	% FULL LOAD	EER (BTUH/WATT)	ANNUAL ENERGY CONSUMPTION (KWH/YR)
100/104	2	18000	100	5	7.2
95/99	25	18000	100	5	90.0
90/94	111	18000	100	5	399.6
85/89	352	18000	83	5	1051.8
80/84	540	18000	67	5	1302.5
75/79	724	18000	50	5	1303.2
70/74	980	18000	33	5	1164.2
65/69	886	18000	17	5	542.2
60/64	763	18000	0	5	0.0
55/59	668	18000	12	5	288.6
50/54	628	18000	25	5	565.2
45/49	503	18000	37	5	776.6
40/44	608	18000	50	5	1094.4
35/39	564	18000	62	5	1258.8
30/34	538	18000	75	5	1452.6
25/29	358	18000	87	5	1121.3
20/24	212	18000	100	5	763.2

ENERGY CONSUMPTION	13181 MBTU	COST	\$279
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FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 2: GROUND WATER-COUPLED HEAT PUMP

01 SEPTEMBER 1993

LOCATION: LA POINTE VILLAGE
NO. QUARTERS: 250
PAGE 2 OF 2

GROUND WATER-COUPLED HEAT PUMP ANALYSIS-PROPOSED ENERGY USAGE

BIN	ANNUAL HOURLY OCCURRENCES	FULL LOAD BTU/HR	% FULL LOAD	EER (BTU/H/WATT)	ANNUAL ENERGY CONSUMPTION (KWH/YR)
100/104	2	18000	100	14	2.6
95/99	25	18000	100	14	32.1
90/94	111	18000	100	14	142.7
85/89	352	18000	83	14	375.6
80/84	540	18000	67	14	465.2
75/79	724	18000	50	14	485.4
70/74	980	18000	33	14	415.8
65/69	886	18000	17	14	193.7
60/64	763	18000	0	14	0.0
55/59	668	18000	12	14	103.1
50/54	628	18000	25	14	201.9
45/49	583	18000	37	14	277.3
40/44	608	18000	50	14	390.9
35/39	564	18000	62	14	449.6
30/34	538	18000	75	14	518.6
25/29	358	18000	87	14	400.4
20/24	212	18000	100	14	272.6

ENERGY CONSUMPTION 4708 MBTU ENERGY COST \$100

DEMAND SAVINGS/UNIT = \$11.78/KW/MO * KW SAVED * 12 MO/YR * 0.75(DIVERSITY FACTOR) = \$245

8473.73 MBTU NET DOLLAR SAVINGS/YR \$424

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 10:46:0

TITLE PAGE

ENERGY SAVINGS OPPORTUNITY SURVY
FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: Keith A. Derrington
Estimate Prep. Date: 08/31/93

Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N
COMPOSER Plus Copyright (C) 1985, 1988
by Building Systems Design, Inc.
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: GWEPEC
5-35

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

TIME 10:46:0

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DETAILED ESTIMATE	DETAIL PAGE
1. BUILDING TO THE 5 FOOT LINE	
AA. GENERAL CONST INSIDE 5 FT LINE.....	1
2. SITEWORK	
AA. EARTHWORK.....	4

* * * END TABLE OF CONTENTS * * *

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
 ECO-2: GROUND WATER COUPLED HEAT PUMPS
 1. BUILDING TO THE 5 FOOT LINE / AA. GENERAL CONST INSIDE 5 FT LINE

TIME 10:46:04

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BIL

DIVISION 15 MECHANICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTY	DIRECT \$
15050 BASIC MATERIALS AND METHODS										
15064 5110 PIPE										
CD=4 PL 5113 1 IN.	*** UNIT COSTS: ***	0.06		1.62		0.02		0.29	0.01	1.91
WC=0800	92400.00 LP MPLUC	5280		149,920		1,980		26,796	1,340	180,036
15100 1300 BALL VALVES										
CD=3 PL 1301 1" BALL VALVES	*** UNIT COSTS: ***	0.40		12.36		0.10		9.80	0.49	22.71
WC=0800	1540.00 EA MPLUC	616		19,032		149		15,092	755	35,027
15100 1400 SOLENOID VALVES										
CD=3 PL 1401 1" SOLENOID VALVE	*** UNIT COSTS: ***	0.88		27.19		0.21		78.00	3.90	109.30
WC=0800	770.00 EA MPLUC	678		20,935		164		60,060	3,003	84,162
15100 1500 FLOW CONTROL VALVES										
CD=3 PL 1501 1" FLOW CONTROL VALVE	*** UNIT COSTS: ***	0.49		15.10		0.12		34.75	1.74	51.71
WC=0800	1540.00 EA MPLUC	753		23,261		182		53,515	2,676	79,634
15100 1600 HOSE BIBS										
CD=3 PL 1601 1" HOSE BIBS	*** UNIT COSTS: ***	0.29		9.06		0.07		5.05	0.25	14.44
WC=0800	770.00 EA MPLUC	226		6,978		55		3,889	194	11,116
15650 REFRIGERATION										
15662 2000 GROUND WATER COUPLE HEAT PUMP & WELL PUMPS										
CD=3 HV 2100 1.5 TON GWCHP W/THERMOSTAT, HOSE	*** UNIT COSTS: ***	9.09		250.40		3.66		1160.00	58.00	1472.06
WC=0900 KIT, 5 YR COMP WARR, FREIGHT INC	250.00 EA MSPFB	2273		62,599		916		290,000	14,500	368,015
CD=3 HV 2200 2.5 TON GWCHP W/THERMOSTAT, HOSE	*** UNIT COSTS: ***	9.52		262.32		3.84		1436.00	71.80	1773.96
WC=0900 KIT, 5 YR COMP WARR, FREIGHT INC	273.00 EA MSPFB	2600		71,613		1,048		392,028	19,601	484,290
CD=3 HV 2300 3 TON GWCHP W/THERMOSTAT, HOSE	*** UNIT COSTS: ***	10.00		275.44		4.03		1637.00	81.85	1998.32
WC=0900 KIT, 5 YR COMP WARR, FREIGHT INC	247.00 EA MSPFB	2470		68,032		995		404,339	20,217	493,584
CD=3 HV 2400 WELL PUMP, 4" SUBMERSIBLE,	*** UNIT COSTS: ***	2.50		77.38		0.95		353.00	17.65	448.98
WC=0900 1/2 HP	523.00 EA MPLUD	1308		40,467		498		184,619	9,231	234,815
CD=3 HV 2500 WELL PUMP, 4" SUBMERSIBLE,	*** UNIT COSTS: ***	2.50		77.38		0.95		430.00	21.50	529.83
WC=0900 3/4 HP	247.00 EA MPLUD	618		19,112		235		106,210	5,311	130,867

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: GWHEP2
5-37

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

TIME 10:46:0

DETAILED ESTIMATE

DETAIL PAGE

1. BUILDING TO THE 5 FOOT LINE / AA. GENERAL CONST INSIDE 5 FT LINE

BASE BI

DIVISION 15 MECHANICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT
15800 AIR DISTRIBUTION										
15816 1100 HEATER W/OPEN COIL ELEMENT										
CD=4 HV 1109 8 KW		*** UNIT COSTS: ***			2.63	72.60	1.02	187.26	9.36	270.2
WC=0900		770.00 EA	MSHMD	2026	55,905	783	144,190	7,210	208,08	
15840 1000 GALV. STEEL SHEET METAL DUCT										
ALLOWANCES FOR WASTES ARE NOT INCLUDED IN PRICING, WASTES SHOULD BE INCLUDED IN WEIGHTS										
CD=4 HV 1004	LOW PRESSURE, SHOP FABRICATION	*** UNIT COSTS: ***			0.05	1.33	0.02	3.06	0.15	4.5
WC=0900	FIELD ASSEMBLY AND INSTALLATION	19250.00 LB	MSHMF	963	25,694	397	58,905	2,945	87,94	
TOTAL DIVISION 15 MECHANICAL					19809	563,548	7,402	1,739,643	86,982	2,397,57

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: GWHPE2
5-38

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS
1. BUILDING TO THE 5 FOOT LINE / AA. GENERAL CONST INSIDE 5 FT LINE

TIME 10:46:00

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT
16050 BASIC MATERIALS AND METHODS									
16111 1100 RIGID GALVANIZED STEEL CONDUIT									
CD=4 EL 1111 3/4 IN CONDUIT W/COUPLING	*** UNIT COSTS: ***			0.06	1.90	0.01	0.69	0.03	2.60
WC=1100	7700.00 LF EELEF		486		14,662	66	5,313	266	20,300
16120 4100 PULLED IN CONDUIT									
CD=4 EL 4101 1 PAIR OF CONDUCTORS	*** UNIT COSTS: ***			24.21	730.01	3.27	134.52	6.73	874.50
WC=1100	30.80 MLF EELEF		746		22,484	101	4,143	207	26,930
TOTAL DIVISION 16 ELECTRICAL				1232	37,146	167	9,456	473	47,240
TOTAL FACILITY AA. GENERAL CONST INSIDE 5 FT LINE				21041	600,694	7,569	1,749,099	87,455	2,444,810
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE				21041	600,694	7,569	1,749,099	87,455	2,444,810

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: GWEPE2
5-39

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
 ECO-2: GROUND WATER COUPLED HEAT PUMPS
 2. SITEWORK / AA. EARTHWORK

TIME 10:46:06

TAILED ESTIMATE

DETAIL PAGE 4

BASE BID

DIVISION 02 SITE WORK	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTY	DIRECT \$
02550 SITE UTILITIES									
02580 1000 DOMESTIC WATER - DRILLED AND CASED - INCLUDING CASING									
CD=4 AA 1001 4 IN (100MM) TO 6 IN (150MM) DIA *** UNIT COSTS: ***				0.24	5.95	3.94	7.69	0.38	17.97
WC=1600 11300.00 VLF CLADM				2739	67,280	44,527	86,897	4,345	203,049
CD=4 AA 1002 8 IN (21CM) DIA. *** UNIT COSTS: ***				0.36	8.77	5.81	9.66	0.48	24.72
WC=1600 13200.00 VLF CLADM				4714	115,783	76,628	127,512	6,376	326,299
TOTAL DIVISION 02 SITE WORK				7454	183,062	121,156	214,409	10,720	529,348
TOTAL FACILITY AA. EARTHWORK				7454	183,062	121,156	214,409	10,720	529,348
TOTAL BID ITEM 2. SITEWORK				7454	183,062	121,156	214,409	10,720	529,348
TOTAL BASE BID				28494	783,757	128,725	1,963,508	98,175	2,974,165
TOTAL ADDITIVE				0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY				28494	783,757	128,725	1,963,508	98,175	2,974,165

*** END OF DETAIL REPORT ***

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: GWHPE2
 5-40

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

TIME 10:46:06

PROJECT NOTES

SUMMARY PAGE 1

PROJECT NOTES

ECO-2: FT CAMPBELL FAMILY HOUSING

SCOPE OF WORK: EVALUATE USE OF GROUND WATER COUPLED HEAT PUMPS IN FAMILY
HOUSING AREAS AT FT CAMPBELL.

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

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BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OPC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	GENERAL CONST INSIDE 5 FT LINE		22.0%	0.0%	7.5%	2.5%	0.0%		
	115500.00 SF	2,444,817	537,860	0	223,701	80,159	0	3,286,537	28.45
BID ITEM TOTAL	1.00 EA	2,444,817	537,860	0	223,701	80,159	0	3,286,537	3286537.23

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

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BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE

BID ITEM 2 SITEWORK

BASE BI.

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COS
AA	EARTHWORK			22.0%	0.0%	7.5%	2.5%	0.0%		
		1000.00 CY	529,348	116,456	0	48,435	17,356	0	711,595	711.6
<hr/>										
BID ITEM TOTAL		1.00 EA	529,348	116,456	0	48,435	17,356	0	711,595	711595.4
<hr/>										
TOTAL BASE BID			2,974,165	654,316	0	272,136	97,515	0	3,998,133	
TOTAL ADDITIVE			0	0	0	0	0	0	0	
<hr/>										
TOTAL INCL ADD			2,974,165	654,316	0	272,136	97,515	0	3,998,133	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: GWHPE2
5-43

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
 ECO-2: GROUND WATER COUPLED HEAT PUMPS

TIME 10:46:06

PROJECT CWE SUMMARY

SUMMARY PAGE 4

ID	BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00 EA	3,286,537		3,286,537	3286537.20
2.	SITEWORK	1.00 EA	711,595		711,595	711595.40
TOTAL CURRENT CONTRACT COST			3,998,133	0	3,998,133	
Cost Growth from 08/93 to 08/94						
	Index Values: 0000 0000	0.0%	0	0	0	
ESCALATED CONTRACT COST			3,998,133	0	3,998,133	
Government-Furnished Property			0		0	
SUBTOTAL			3,998,133	0	3,998,133	
Contingencies			10.0%	399,813	0	399,813
SUBTOTAL			4,397,946	0	4,397,946	
SIOH (S&A)			5.0%	219,897	0	219,897
CURRENT WORKING ESTIMATE			4,617,843	0	4,617,843	
Estimated Construction Time			365 Days			

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: GWHPE2
 5-44

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

TIME 10:46:06

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		115500.00	SF	28494	783,757	128,725	2,061,683		2,974,165	100.0%	0	2,974,165
	TOTAL DIRECT				28494	783,757	128,725	2,061,683		2,974,165	100.0%		

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

TIME 10:46:04

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 6

----- *** OVERHEAD *** ----- **** PROFIT **** ----- ***** TOTAL CONTRACT *****											
ID	CONTRACTOR	PM	SUBTOTAL	AMOUNT	PCT	HOFC%	AMOUNT	PCT	BOND%	OTHER%	UNIT COST
AA	GENERAL/PRIME		2,974,165	654,316	22.0%	0.0	272,136	7.5%	2.5%	0.0%	34.62
	TOTAL OVERHEAD & PROFIT			654,316	22.0%		272,136	7.5%			

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

TIME 10:46:06

CSI DIVISION SUMMARY

SUMMARY PAGE 7

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
02 SITE WORK	7454	183,062	121,156	214,409	10,720	529,348
15 MECHANICAL	19809	563,548	7,402	1,739,643	86,982	2,397,576
16 ELECTRICAL	1232	37,146	167	9,456	473	47,242
TOTAL DIRECT	28494	783,757	128,725	1,963,508	98,175	2,974,165

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: GWEPE2
5-47

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

TIME 10:46:04

SYSTEMS SUMMARY

SUMMARY PAGE 8

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
08 PLUMBING	7552	220,126	2,530	159,352	7,968	389,975
09 HEATING, VENTILATION & AIR CONDIT	12257	343,422	4,872	1,580,291	79,015	2,007,601
11 INTERIOR ELECTRICAL	1232	37,146	167	9,456	473	47,242
16 SITE UTILITIES	7454	183,062	121,156	214,409	10,720	529,348
TOTAL DIRECT	28494	783,757	128,725	1,963,508	98,175	2,974,165

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: GWHPE2
5-48

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

TIME 10:46:06

EQUIPMENT SUMMARY

SUMMARY PAGE 9

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	UPB	HOURS	TOTAL	COST
EMI20 SMALL TOOLS								1.40	1.40	5974	8,363	
ETR50 TRUCK & DRILL RIG, 335 HP, 6-3/4								80.74	80.74	1491	120,362	
TOTAL PROJECT EQUIPMENT HOURS										7465	128,726	

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-2: GROUND WATER COUPLED HEAT PUMPS

TIME 10:46:06

LABOR SUMMARY

SUMMARY PAGE 1C

CRAFT	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC	ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	1232	37,147
LLABR	LABORER/HELPER	17.25	0.0%	24.0%	3.07	0.00	24.46	18.52	9841	241,449
LPLUM	PLUMBERS	21.25	0.0%	24.0%	4.50	0.00	30.85	25.55	7365	228,045
LSHMT	SHEET METAL WORKERS	19.90	0.0%	24.0%	5.20	0.00	29.88	25.06	2714	74,873
LSPFI	STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	7343	202,245
TOTAL PROJECT MANHOURS									28495	783,759

* * * END OF SUMMARY REPORT * * *

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: GWHEP2
5-50



***Bard Water Source Heat Pumps
Tap Into The Most Efficient
Energy Source Available...
Ground Water***



The Bard Water Source Heat Pumps

ADVANCED TECHNOLOGY IN HOME COMFORT.

Bard Water Source Heat Pumps give you the most energy-efficient technology available today. Functioning as both a furnace and an air conditioner, they are designed to provide economical, year-round comfort by utilizing an abundant natural resource, the earth's heat. As the air's temperature fluctuates between hot and cold, the earth's ground water temperature remains fairly constant, between 45 and 72 degrees. In winter months, Bard Water Source Heat Pumps capture this natural heat and use it to provide space heating and supplemental water heating for your home. In summer months, the process is reversed. Heat and humidity within your home are dissipated into the earth's ground and its water to provide central air conditioning.

This technologically advanced home comfort system actually saves you money by using less energy than other conventional sources. In fact, Bard Water Source Heat Pumps generate at least three times as much heat energy than they consume (a Coefficient of Performance (COP) of 3.0 or more (300% efficiency). They're the smart choice for homeowners who want quality and performance in an efficient heating and cooling unit.

MAXIMUM EFFICIENCY FROM TWO ECONOMICAL SYSTEMS.

A Bard Water Source Heat Pump System is comprised of the heat pump, located inside the home, and a water system outside the home. When installing a unit, you have the choice of a closed-loop or an open-loop water system. The amount of ground water available or your preference for a closed-loop system will determine which system to install.

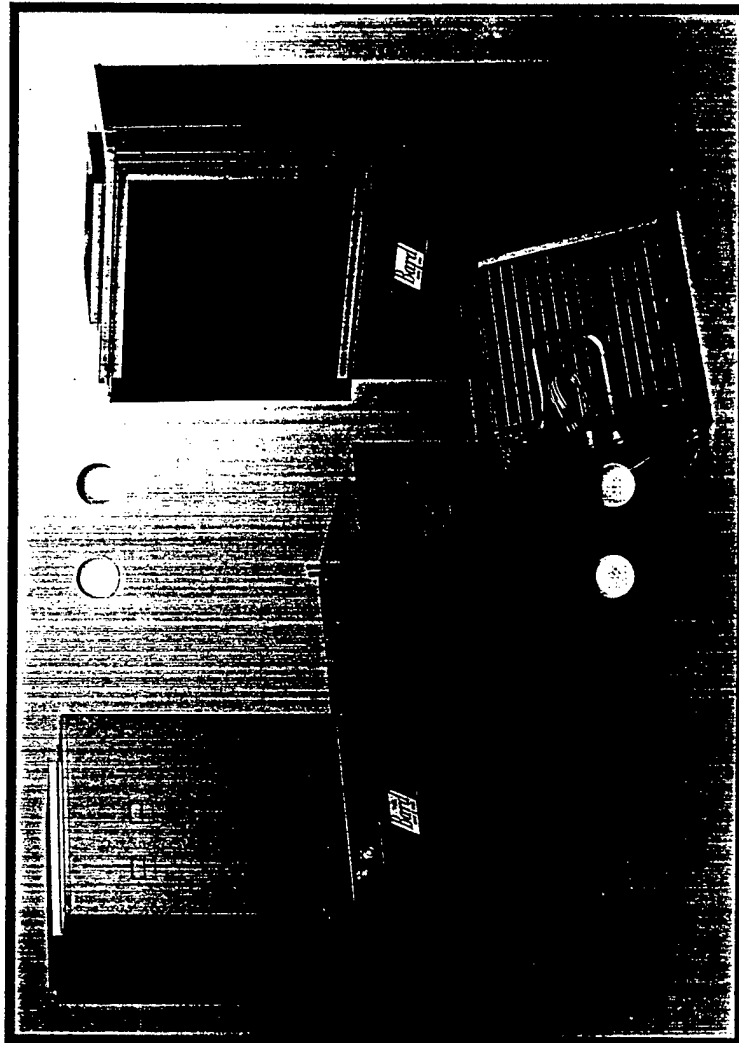
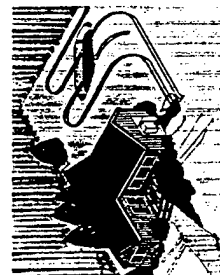
An open loop system

requires a readily available source of ground water such as a lake, pond or well. In the winter, water is drawn from the available source and circulated through your Bard Heat Pump which removes the heat and warms your home. In the summer, the process is reversed. Heat in your home is removed and transferred back to the earth's ground water.

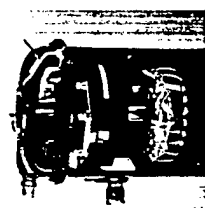


A closed loop system

uses a loop of special buried plastic pipe. It can be horizontally or vertically installed in the ground or coiled and sunk in a lake or pond. This Bard system collects heat from the ground by continuously circulating water or water with an anti-freeze solution through this underground or underwater loop, extracting heat in the winter and dissipating heat in the summer.



COPRO-NICKEL COAXIAL W/ COIL maintains heat transfer efficiency and resists corrosion. minimal back-up with airtight construction.



THE COPPELAND™ SCROLL™ COMPRESSOR of the WQS Series offers superior efficiencies and quieter performance.



MATCHING BARD EVAPORATOR COILS provide outstanding heat control and maintain 112° db.



THE HOT WATER HEAT EXCHANGER is an optional accessory that supplements your hot water needs while providing significant energy savings. (Model HHE2-50)



INTERPRET FACTORY TESTING—an integral part of Bard's commitment to quality. Every unit undergoes air pressure, leak and operating air tests before being packaged for



LISTED
CERTIFIED

The Bard WQS Series

Our WQS Series of split system Heat Pumps provide maximum efficiency and quiet operation through the use of a totally efficient Copeland™ Scroll™ Compressor. The units can be used as a primary source of heating and air conditioning or as an "add-on" to existing oil or gas furnaces. For "add-on" applications, the system can cost effectively supplement existing warm air heating systems and provide central air conditioning. The WQS Series is ideal for replacement, remodeling or retrofit applications and can be used with both closed and open loop systems.

The Bard WPV Series

Bard's WPV Series of Water Source Heat Pumps integrate an efficient reciprocating compressor, indoor air coil and air handling unit within one space-saving packaged system. They provide proven long term durability as a primary heating and air conditioning source for new applications or as a replacement for existing forced air heating systems. Suited for both closed and open loop applications, the WPV Series offers highly efficient units perfect for small installation areas such as closets, basements or utility rooms.

Economical Water Source Benefits

- Offer cost-effective operating efficiency
- Provide quiet and environmentally responsible operation
- Reduce the demand on natural energy resources
- Are virtually maintenance free
- Require no outside venting or outdoor equipment installation
- Allow for safe operation—no flames or exhaust fumes given

ENERGY SAVINGS IN SUPPLEMENTAL WATER HEATING. For even more efficient use of your Bard Water Source Heat Pump, an optional fixed installed Hot Water Heat Exchanger is available. Compared to conventional electric water heaters, a Bard Heat Exchanger offers a 100% energy savings during summer operation by heating your water with the rejected heat from the compressor. By supplementing your hot water needs during the winter, the heat exchanger can save you 60% in energy over conventional electric water heaters.

The Smart Choice For Efficiency

Bard Water Source Heat Pumps really are the smart choice when heating and cooling your home. In a study comparing costs to heat and cool an 1800 sq. foot home in Dayton, Ohio, with heating requirements of 30,000 cooling and 55,000 heating, Bard Water Source units provided significant savings over conventional sources.

Bard Water Source Heat Pump
Heating=\$787.85
Cooling=\$146.82
Total=\$934.67



Fuel Oil
Heating=\$1128.87
Cooling=\$197.76
Total=\$1326.63



Air Source Heat Pump
Heating=\$1240.91
Cooling=\$197.76
Total=\$1438.67



Natural Gas
Heating=\$739.09
Cooling=\$197.76
Total=\$936.85



Propane Gas
Heating=\$1194.79
Cooling=\$197.76
Total=\$1392.55



Comparison based on all units meeting 1992 efficiency standards

- * Gas and Oil Furnace = 78% AFUE
- * Air Source Heat Pump = 10.0 SEER and 6.80 HSPF
- * Air Conditioners = 10.0 SEER
- * Water Source Heat Pump = 13.5 EER and 2.92 COP

Cost figures based on Department of Energy Report, March, 1991

Electricity 8.24¢/KWh
Natural Gas 60.5¢/therm or 56.23/MCF
No. 2 Heating Oil \$1.29/gallon
Propane \$0.89/gallon



BARD QUALITY Since Bard began manufacturing heating and cooling products back in 1914, our company has grown in hundreds of ways. But some things never change. Our commitment to quality is one of them.

At Bard, only the finest materials and workmanship go into our products. All components are carefully tested during production. And every unit is test-operated before packaging.

That extra concern for quality. It's what makes Bard one of America's leading manufacturers of heating and cooling products today. It has since 1914.

Bard Manufacturing Company

1914 Randolph Drive
Bryan, Ohio 43506

Form No. S3039 July, 1991

©1991 MHI-7.5M Litho 5-153A



HIGH EFFICIENCY WATER SOURCE SPLIT SYSTEM HEAT PUMPS

SUITABLE FOR:

GROUND WATER APPLICATION — WATER TEMP. 45°-75°F

EARTH LOOP APPLICATION — TEMP. RANGE 30°-110°F

Cooling Capacities: Up to 43,500 BTU EER: Up to 14.2

Heating Capacities: Up to 49,500 BTU COP: Up to 3.5



Designed for Low Water Consumption



The Bard Water Source Split System Heat Pump delivers economical, year-

round comfort by utilizing nature's most abundant and efficient solar energy collector — ground water. It costs 70% less to operate than resistance type heaters, 50% less than oil, and 35% less than gas. Plus, it cools and dehumidifies in the summer resulting in a savings of up to 50% over conventional air conditioning.

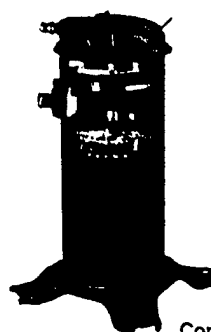
Compressor Unit

All units are shipped prewired for fast, easy installation in residential or commercial buildings. They are available in three popular models. And for added versatility, an optional domestic hot water heat exchanger can be field installed to reduce hot water heating costs an extra 29-44%.

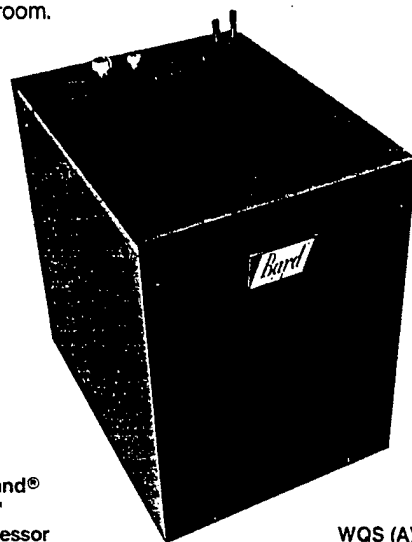
The Bard Water Source Split System Heat Pump makes the perfect "add-on" to oil, gas or electric furnaces. It can also be used for independent heating/cooling applications.

Totally enclosed for quiet, indoor operation. Absorbs heat from ground water on heating cycle; disperses heat to

ground water on cooling cycle. Designed for easy hook-up to supply water system. Ideal for closet, basement or utility room.



Copeland® Scroll™ Compressor



WQS (A)

Engineered Features

Steel Cabinet:

Finished with baked-on polyester enamel in a sound-insulated cabinet that houses the compressor and water coil section.

High Efficiency Scroll Compressor:

Energy Efficient — The scroll compressor offers a smooth, continuous compression process with very few flow losses. In addition, it requires no valves and, therefore, eliminates all valve losses. Finally, unlike a piston, the scroll compressor's suction and discharge locations are separate, substantially reducing heat transfer between the suction and discharge gas. The net result is higher energy efficiency than piston technology.

Volumetric Efficiency:

Scroll has no re-expansion volume, which increases compressor capacity in high compression ratio operating conditions.

Sound:

Scroll's low gas pulses, combined with the elimination of valves (and associated valve noise), result in a smooth and quiet compression process. When compared with piston type compressors for sound and noise, scroll is superior.

5 Minute Compressor Time Delay:

Provides short cycle protection.

Lockout Circuit:

Permits remote resetting of safety controls from room thermostat.

High and Low Pressure Controls:

Stop unit in the event of water loss and prevent coil freeze up.

Service From Top:

Permits easy access to electrical and water piping connections.

Control Circuit:

Specially designed to permit heat pump operation below

building thermal balance point. Maximizes energy savings when using as an "add-on" to fossil fuel furnace.

Cupro-Nickel Coaxial: Water coil.

Fully Insulated Water Coil: Our standard cupro-nickel water to refrigerant coil is completely insulated to prevent frost build-up at low temperature operation.

Service Access Ports:

Permit service pressure check of discharge and suction pressures.

Thermostatic Expansion Valve:

For wide range refrigerant control.

Waste Heat Recovery Valve:

Specially integrated inlet and outlet valves provide for installation of a hot water heat exchanger.

Optional Accessories:

Room thermostat, water flow controls, loop pump modules, and hose kits.

Optional Low Temperature Thermostat:

Senses refrigerant temperature and shuts off the compressor should extremely low anti-freeze temperature or loss of fluid flow occur. Required for earth loop applications.

Optional Field Installed HRU2-B Exchanger:

Double wall vented heat exchanger, sealed ball bearing water pump, secondary hot water thermostat, internally fused, disconnect switch, air bleed port and refrigerant port.

VERIFIED
FOR ENERGY
PERFORMANCE



Specifications

MODEL	WQS30A	WQS36A	WQS42A
ELECTRICAL RATING (60HZ/V/PH)	230/208-1	230/208-1	230/208-1
Operating Voltage Range	197-253	197-253	197-253
Minimum Circuit Ampacity	18	23	32
+ Field Wire Size	#12	#10	#8
++ Delay Fuse Maximum of Ckt Bkr	30	40	55
Total Unit Amps 230/208	12.65/13.95	14.4/16.65	20.0/24.5
COMPRESSOR			
Volts	230/208	230/208	230/208
Rated Load Amps 230/208	12.65/13.95	14.4/16.65	20.0/24.5
Branch Ckt. Selection Current	13.9	18.0	25.0
Lock Rotor Amps 230/208	76/76	90.5/90.5	107/107
CONDENSER			
Coaxial-Water	Cupro-Nickel	Cupro-Nickel	Cupro-Nickel
Water Connections	3/4" FPT	3/4" FPT	1" Hose
REFRIGERANT CONNECTION AND CHARGE			
Suction Line Fitting	-10	-10	-12
Liquid Line Fitting	-6	-6	-6
Factory Charge R-22 Oz.	51 oz.	56.5 oz.	88.5 oz.
Shipping Weight lbs.	135	150	210

+60 degree C copper wire size

++Maximum time delay fuse or HACR type circuit breaker

Legend

EWT = Entering water temperature °F
(or fluid temperature if applicable)
GPM = Water flow rate — gallons per minute
EAT = Entering air temperature °F
(dry bulb/wet bulb)
TC = Total cooling capacity Btu/Hr
SC = Sensible cooling capacity Btu/Hr
THR = Total heat of rejection Btu/hr
EER = Energy efficiency ratio — total cooling ÷ total unit watts
TH = Total heating capacity Btu/Hr
THA = Total heat of absorption Btu/hr
COP = Coefficient of performance — total heating ÷ (total unit watts × 3.413)
ESP = External static pressure (inches of water)

Capacity and Efficiency Ratings (Ground Water Source Heat Pump) ARI Certified

CONDENSING UNIT MODEL NO.	EVAPORATOR COIL MODEL NUMBER	① TYPE	RATED AIRFLOW		GPM	COOLING ①				HEATING ①				REQUIRED REFRIGERANT CONTROL ORIFICE SIZE
			CFM	① H2O		70°F EWT		50°F EWT		70°F EWT		50°F EWT		
						BTU/HR	EER	BTU/HR	EER	BTU/HR	COP	BTU/HR	COP	
WQS30A	BC24B	B	875	.15	5	30200	11.7	31600	14.0	33000	3.20	26400	2.80	.069 ◀
WQS30A	A36AQ-A ③	A	1100	.23	5	30600	11.6	30800	13.3	34000	3.50	26600	3.00	.067
WQS36A	BC36B	B	1150	.15	5	37000	11.8	37800	14.0	40000	3.50	32600	3.10	.067 ◀
WQS36A	A36AQ-A ③	A	1200	.25	5	36200	11.5	36800	13.6	41000	3.50	34000	3.10	.067
WQS42A	BC36B	B	1140	.21	6	40000	11.7	41500	14.2	46500	3.20	37400	2.80	.076 ◀
WQS42A	A42AQ-A ③	A	1440	.23	6	41500	11.6	43500	14.0	49500	3.40	40000	3.00	.078

Capacity and Efficiency Ratings (Closed-Loop Heat Pump) ②

CONDENSING UNIT MODEL NO.	EVAPORATOR COIL MODEL NUMBER	① TYPE	RATED AIRFLOW		GPM	COOLING* ①		HEATING ①		REQUIRED REFRIGERANT CONTROL ORIFICE SIZE
			CFM	① H2O		77°F EWT		32°F EWT		
						BTU/HR	EER	BTU/HR	COP	
WQS30A	BC24B	B	875	.15	6	30000	12.5	22600	2.9	.069 ◀
WQS30A	A36AQ-A	A	1100	.23	6	30800	12.2	22800	3.0	.067
WQS36A	BC36B	B	1150	.15	6	37400	12.0	26800	3.0	.067 ◀
WQS36A	A36AQ-A	A	1200	.25	6	36800	12.2	29200	3.0	.067
WQS42A	BC36B	B	1140	.21	7	40500	12.4	31000	2.9	.076 ◀
WQS42A	A42AQ-A	A	1440	.23	7	42000	12.9	30600	2.8	.078

① Rated in accordance with ARI standard 325, "Standard for Ground Water Source Heat Pumps," which includes Watt allowance for water pumping.

Cooling capacity based on 80°F DB 67°F WB entering air temperature.

Heating capacity based on 70°F DB entering air temperature.

② Tested in accordance with ARI Standard 330-90 "Ground Source Closed-Loop Heat Pumps," which includes watt allowance for water pumping.

③ Indoor coil type A = "A" Coil B = Blower Coil

④ Static pressure loss for add-on "A" coils and available static pressure for duct systems on blower coils.

⑤ C.S.A. verified for energy performance.

IMPORTANT INFORMATION

◀ Orifice change required for indoor coil to orifice size shown. Correct size orifice is shipped with condensing unit and packaged with the installation instructions for unit.

Capacity Multiplier Factors

% OF RATED AIR FLOW	-10	RATED	+10
Total Btuh	0.975	1.0	1.02
Sensible Btuh	.95	1.0	1.05

Correction Factors for Performance at Other Water Flows

HEATING			COOLING	
Rated Flow Plus—GPM	BTUH	WATTS	BTUH	WATTS
2	1.00	98	1.01	1.00
4	1.01	97	1.03	1.01
6	1.02	96	1.05	1.02
8	1.02	95	1.06	1.02

Water Coil Pressure Drop

MODEL	WQS30A		WQS36A		MODEL	WQS42A	
GPM	PSIG	Ft. Hd.	PSIG	Ft. Hd.	GPM	PSIG	Ft. Hd.
4	2.0	4.6	1.9	4.4	6	2.5	5.8
5	3.0	6.9	2.0	4.6	7	3.2	7.4
6	4.2	10.0	2.4	5.5	8	4.0	9.2
7	5.7	13.1	3.0	6.9	9	5.2	12.0
8	7.5	17.3	3.9	9.0	10	6.5	15.0
9	9.5	21.9	5.5	12.7	11	7.7	17.8
10	12.0	27.7	7.6	17.5	12	9.0	20.8
11	14.8	34.1	10.4	24.0	13	10.5	24.2
12	17.6	40.6	15.3	35.3	14	12.0	27.7
13	20.3	46.8	20.6	47.5			

Capacity and Efficiency Application Ratings

WQ538A W/AMAZON		COOLING				HEATING			
EWTD	GPM	EAT	TC	SC	THRU	FEED	EAT	THRU	THA
30	5	75/62 80/67 85/72	30500 31100 35000	24100 24600 25500	37800 40400 44500	18.30 18.80 19.50	70	19200	11800
40	5	75/62 80/67 85/72	30400 31000 34800	23800 24400 25400	37700 40200 44200	17.30 17.80 18.40	70	22900	15700
50	5	75/62 80/67 85/72	30000 30800 34700	23500 24200 25300	37600 40000 44000	16.20 16.70 17.20	70	26600	19500
60	5	75/62 80/67 85/72	29600 30700 34600	23200 23900 25100	37400 39800 43700	15.00 15.50 15.90	70	30300	23400
70	5	75/62 80/67 85/72	29400 30600 34500	22800 23600 24800	37000 39400 43300	13.80 14.20 14.60	70	34000	27200
80	5	75/62 80/67 85/72	28800 30000 33700	22400 23200 24400	36500 38800 42700	12.50 12.80 13.20	70	37700	31100
90	5	75/62 80/67 85/72	27600 29400 32300	22000 22800 24000	35700 38100 41800	11.10 11.40 11.70			
100	5	75/62 80/67 85/72	26000 27700 30500	21600 22300 23500	34900 37100 40800	9.60 9.90 10.20			
110	5	75/62 80/67 85/72	24000 25600 28100	21800 22900 25000	33800 36000 39600	8.00 8.30 8.50			

WQ538A W/AMAZON		COOLING				HEATING			
EWTD	GPM	EAT	TC	SC	THRU	FEED	EAT	THRU	THA
30	5	75/62 80/67 85/72	30000 31900 35300	19800 20500 21700	36000 38600 42200	18.80 19.30 20.00	70	19400	14200
40	5	75/62 80/67 85/72	29800 31800 34800	19700 20300 21400	35800 38200 41900	17.80 18.00 18.70	70	22900	17100
50	5	75/62 80/67 85/72	29700 31600 34700	19600 20200 21200	35700 38000 41800	16.60 17.10 17.60	70	26400	20000
60	5	75/62 80/67 85/72	29400 31300 34300	19500 20100 21100	35600 37900 41600	15.30 15.90 16.40	70	29900	22900
70	5	75/62 80/67 85/72	28700 30200 33600	19400 20000 21000	35200 37500 41200	14.00 14.50 15.00	70	33000	25800
80	5	75/62 80/67 85/72	27700 29600 32500	19200 19800 20700	34700 37000 40500	12.60 13.00 13.50	70	36900	28700
90	5	75/62 80/67 85/72	26500 28300 31000	18900 19400 20400	33900 36000 39600	11.00 11.50 11.90			
100	5	75/62 80/67 85/72	24900 26600 29200	18400 19000 19900	33000 35100 38500	9.40 9.80 10.10			
110	5	75/62 80/67 85/72	23000 24600 27000	17900 18500 19400	31800 33800 37100	7.70 8.00 8.20			

WQ538A W/AMAZON		COOLING				HEATING			
EWTD	GPM	EAT	TC	SC	THRU	FEED	EAT	THRU	THA
30	5	75/62 80/67 85/72	35400 37400 41100	26600 27400 28600	44600 48000 52900	17.80 18.40 19.00	70	26800	17300
40	5	75/62 80/67 85/72	35200 37100 41000	26400 27200 28500	44400 47800 52700	16.70 17.30 17.80	70	30600	21300
50	5	75/62 80/67 85/72	35000 36800 40900	26100 26900 28200	44200 47600 52500	15.60 16.10 16.60	70	34000	25300
60	5	75/62 80/67 85/72	34900 36400 40800	26000 26400 28000	44100 47500 52100	14.40 14.90 15.30	70	38200	29300
70	5	75/62 80/67 85/72	34800 36200 40700	25900 26600 27900	44000 46900 51500	13.20 13.60 14.00	70	41000	33300
80	5	75/62 80/67 85/72	34200 35800 40000	25800 26500 27800	43800 46700 51300	11.90 12.30 12.60	70	45800	37300
90	5	75/62 80/67 85/72	33200 35300 38900	25700 26400 27700	43000 45900 50400	10.60 10.90 11.20			
100	5	75/62 80/67 85/72	31800 33900 37300	25300 26100 27300	41700 44500 48900	9.20 9.50 9.70			
110	5	75/62 80/67 85/72	30000 32000 35200	24700 25500 26700	39900 42500 46700	7.80 8.00 8.20			

WQ538A W/AMAZON		COOLING				HEATING			
EWTD	GPM	EAT	TC	SC	THRU	FEED	EAT	THRU	THA
30	5	75/62 80/67 85/72	36200 38200 42000	26500 27000 28500	44400 47000 52700	18.60 19.20 19.80	70	24800	17200
40	5	75/62 80/67 85/72	35900 38000 41800	26300 26900 28200	44200 46900 52500	17.30 17.90 18.40	70	28700	21100
50	5	75/62 80/67 85/72	35500 37800 41500	26000 26800 28000	44000 46800 52300	16.00 16.50 17.00	70	32600	25000
60	5	75/62 80/67 85/72	35300 37600 41300	25900 26700 27900	43800 46700 51900	14.70 15.10 15.60	70	36500	28900
70	5	75/62 80/67 85/72	35100 37000 41100	25800 26600 27800	43700 46500 51100	13.30 13.70 14.10	70	39800	32800
80	5	75/62 80/67 85/72	34100 36400 40000	25700 26500 27600	43400 46200 50700	11.90 12.30 12.60	70	44300	36700
90	5	75/62 80/67 85/72	32700 34800 38300	25300 26100 27400	42700 45400 49900	10.50 10.80 11.10			
100	5	75/62 80/67 85/72	30700 32700 36000	24400 25300 26500	41500 44200 48500	9.10 9.40 9.60			
110	5	75/62 80/67 85/72	28200 30100 33100	23200 24000 25200	39900 42500 46700	7.60 7.90 8.10			

WQ542A W/AMAZON		COOLING				HEATING			
EWTD	GPM	EAT	TC	SC	THRU	FEED	EAT	THRU	THA
30	6	75/62 80/67 85/72	41400 43900 48300	30000 31000 32700	51400 54600 60100	19.20 19.80 20.40	70	30000	19200
40	6	75/62 80/67 85/72	41100 43700 48100	29900 30900 32400	51200 54400 59900	17.70 18.20 18.80	70	35000	24300
50	6	75/62 80/67 85/72	40800 43500 47800	29800 30800 32300	51000 54200 59700	16.20 16.70 17.20	70	40000	29400
60	6	75/62 80/67 85/72	40300 42900 47200	29700 30700 32200	50800 54000 59500	14.70 15.20 15.60	70	45000	34500
70	6	75/62 80/67 85/72	39400 41500 46200	29600 30600 32100	50700 53900 59300	13.30 13.70 14.10	70	49500	39600
80	6	75/62 80/67 85/72	38300 40800 44900	29400 30400 31900	50400 53500 58900	11.90 12.30 12.60	70	55000	44700
90	6	75/62 80/67 85/72	36800 39200 43200	29200 30200 31600	49500 52500 57800	10.60 10.80 11.10			
100	6	75/62 80/67 85/72	35100 37200 41100	28900 30000 31300	48000 50900 56100	9.20 9.50 9.70			
110	6	75/62 80/67 85/72	33000 35200 38700	28600 29500 30900	46000 48700 53600	7.90 8.10 8.30			

WQ542A W/AMAZON		COOLING				HEATING			
EWTD	GPM	EAT	TC	SC	THRU	FEED	EAT	THRU	THA
30	6	75/62 80/67 85/72	40000 42200 46800	27200 28100 29400	48400 51800 56600	20.10 20.70 21.30	70	28500	18300
40	6	75/62 80/67 85/72	39800 41800 46600	27000 27900 29200	48200 51400 56400	18.50 19.00 19.60	70	33300	22900
50	6	75/62 80/67 85/72	39400 41500 46200	26800 27800 29000	48000 51200 56200	16.80 17.30 17.80	70	37500	27400
60	6	75/62 80/67 85/72	39200 40800 46000	26600 27500 28900	47800 51000 56000	15.20 15.60 16.10	70	42800	32000
70	6	75/62 80/67 85/72	38500 40000 45100	26500 27400 28800	47700 50800 55900	13.60 14.00 14.40	70	46500	36500
80	6	75/62 80/67 85/72	37000 39400 43400	26200 27100 28500	47500 50600 55600	12.00 12.40 12.80	70	52300	41100
90	6	75/62 80/67 85/72	34900 37200 40900	25800 26600 28000	46800 49800 54800	10.60 10.80 11.10			
100	6	75/62 80/67 85/72	32100 34200 37600	25100 25900 27300	45600 48600 53500	9.00 9.30 9.50			
110	6	75/62 80/67 85/72	28600 30500 33500	24200 25000 26300	44000 46400 51600	7.60 7.80 8.00			

- ① Unit only
② Requires anti-freeze solution

Water Flow Control Accessories For Ground Water Application

REQUIRED FOR ALL MODELS			
MODEL	BARD PART NO.	QTY. REQ'D	DESCRIPTION
WQS30A WQS36A	8603-011	1	Constant flow valve 5 GPM 1/2" MPT
WQS42A	8603-007	1	Constant flow valve 6 GPM 1/2" MPT
All	8603-016	1	Solenoid valve 1/2" MPT
All	8603-012	1	Optional Flow Meter 1-10 GPM 1/2" MPT used to measure water flow through system may be permanently installed.
All	8603-017	1	Optional Flow Meter 1-17 GPM 1" FPT used to measure water flow through system may be permanently installed.

Domestic Hot Water Heat Exchanger (HRU2-5B)

The domestic hot water heating system works on the principle of refrigerant-to-water heat exchange. This system is designed specifically to heat water with the rejected heat from the heat pump compressor. Each heat recovery unit includes a specially designed heat recovery coil (heat exchanger) which is an integral part of the basic heat pump unit construction.

DOMESTIC HOT WATER HEATING PERFORMANCE				
Model	Thermostat Position	Ground Water Temp	Heat Pump Recovery Rate (Gal/hr Ground Water @ 55°F)	Water Heating Rate (GPM) @ 55°F
WQS30A WQS36A	Heat①	50	4.4	5
		70	6.5	5
	Cool②	50	2.9	5
		70	4.2	5
WQS42A	Heat①	50	5.6	6
		70	8.0	6
	Cool②	50	2.5	6
		70	4.7	6

- ① Automatically regulated with water constant flow valves.
- ② When heat pump is in heating mode and operating, it heats water at a COP of 3.2 for a 67% energy savings over conventional electric water heaters.
- ③ When heat pump is in cooling mode and operating, it heats water for free, offering a 100% energy savings over conventional electric water heaters.

Flow Rates Required To Maintain Rated Capacity

	WQS30A WQS36A	WQS42A
Flow rate required GPM water	5	6
Flow rate required GPM 15% propylene glycol*	6.5	7.8
Flow rate required GPM 30% propylene glycol*	8.0	9.6

*For earth loop application with anti-freeze solution.

Charged Tubing

MODEL NO.	Stub Tube	15'	25'	35'	45'
WQS30A WQS36A	CTO*	CT15 3/8" & 3/4"	CT25 1/4" & 3/4"	CT35 3/8" & 3/4"	CT45 3/8" & 3/4"
WQS42A	CTO-12*	CT15-12 3/8" & 7/8"	CT25-12 3/8" & 7/8"	CT35-12 3/8" & 7/8"	CT45-12 3/8" & 7/8"

*1/2 stub kit available — CTO-A or CTO-12A.

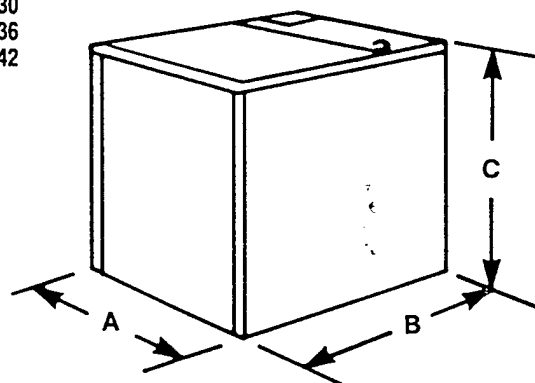
Add-On Component Selection List

Heat Pump Compressor Section	Coil Section	Efficiency Type	Part No.	Qty.	Part No.
WQS30A, WQS36A	A36AQ-A	Gas	8403-017	1	T874R1129 Thermostat
			8404-009	1	Q674L1181 Subbase
WQS30A, WQS36A	A36AQ-A	Oil	8403-017	1	T874R1129 Thermostat
			8404-009	1	Q674L1181 Subbase
			8201-015	1	Isolating Relay
WQS30A	BC24B	*None	8403-017	1	T874R1129 Thermostat
			8404-009	1	Q674L1181 Subbase
WQS36A	BC36B	*None	8403-017	1	T874R1129 Thermostat
			8404-009	1	Q674L1181 Subbase
WQS42A	A42AQ-A	Gas	8403-017	1	T874R1129 Thermostat
			8404-009	1	Q674L1181 Subbase
			8201-015	1	Isolating Relay
WQS42A	A42AQ-A	Oil	8403-017	1	T874R1129 Thermostat
			8404-009	1	Q674L1181 Subbase
			8201-015	1	Isolating Relay
WQS42A	BC36B	*None	8403-017	1	T874R1129 Thermostat
			8404-009	1	Q674L1181 Subbase

*Blower coil application. Suitable for upflow, horizontal or counterflow application.

Compressor Water Coil Section

WQS30
WQS36
WQS42



Dimensions

MODEL NO.	WQS30A, WQS36A	WQS42A
A-Width	18"	22"
B-Depth	23 1/2"	28"
C-Height	24"	24"



BARD MANUFACTURING CO.
BRYAN, OHIO 43506
Since 1914... Moving ahead,
just as planned.

Specifications subject to
change without notice.

Before purchasing this appliance, read
important energy cost and efficiency
information available from your retailer.

Form No.
S3184
May, 1993

(Supersedes S3184-791)

5-57

6 HEAT RECLAIM AT THE COMMISSARY

The ECO evaluation consisted of quantifying the available heat that was recoverable and determining the best use of the heat. The heat is recovered from the hot suction gases after they leave before the gases pass through the condensing units. The heat is recovered in a shell and tube heat exchanger. The system consists of four heat exchangers. Two of the heat exchangers add heat to a circulating loop that serves restrooms and the employee break area. The other two heat exchangers add heat to the circulating loop that serves the produce, meat and other food processing areas.

This section contains the analysis results for the study on heat reclaim at the commissary. Included in this section are two figures describing the layout of refrigeration equipment, the life cost analysis, cost estimate, and energy calculations for the project.

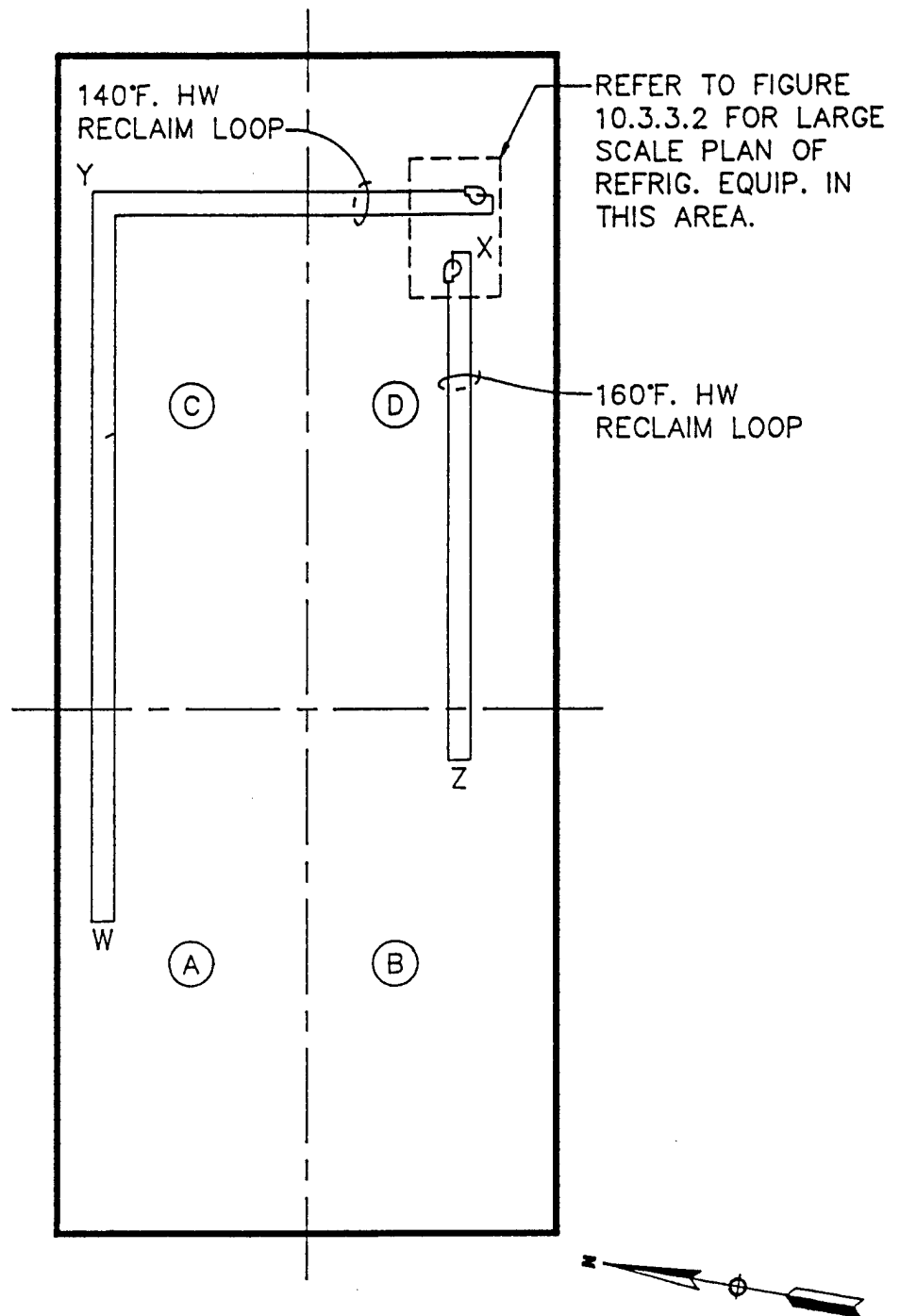


FIGURE 10.3.3.1 - COMMISSARY & RECLAIM LOOP PIPING LAYOUT

SCALE: 1" = 75'

- W = APPROXIMATE LOCATION OF 60 GALLON, 140°F HOT WATER HEATER
- X = APPROXIMATE LOCATION OF REFRIGERATION ROOM (IN MEZZ. AREA)
- Y = APPROXIMATE LOCATION OF 42 GALLON, 140°F. HOT WATER HEATER
- Z = APPROXIMATE LOCATION OF 450 GALLON, 160°F. HOT WATER SYSTEM

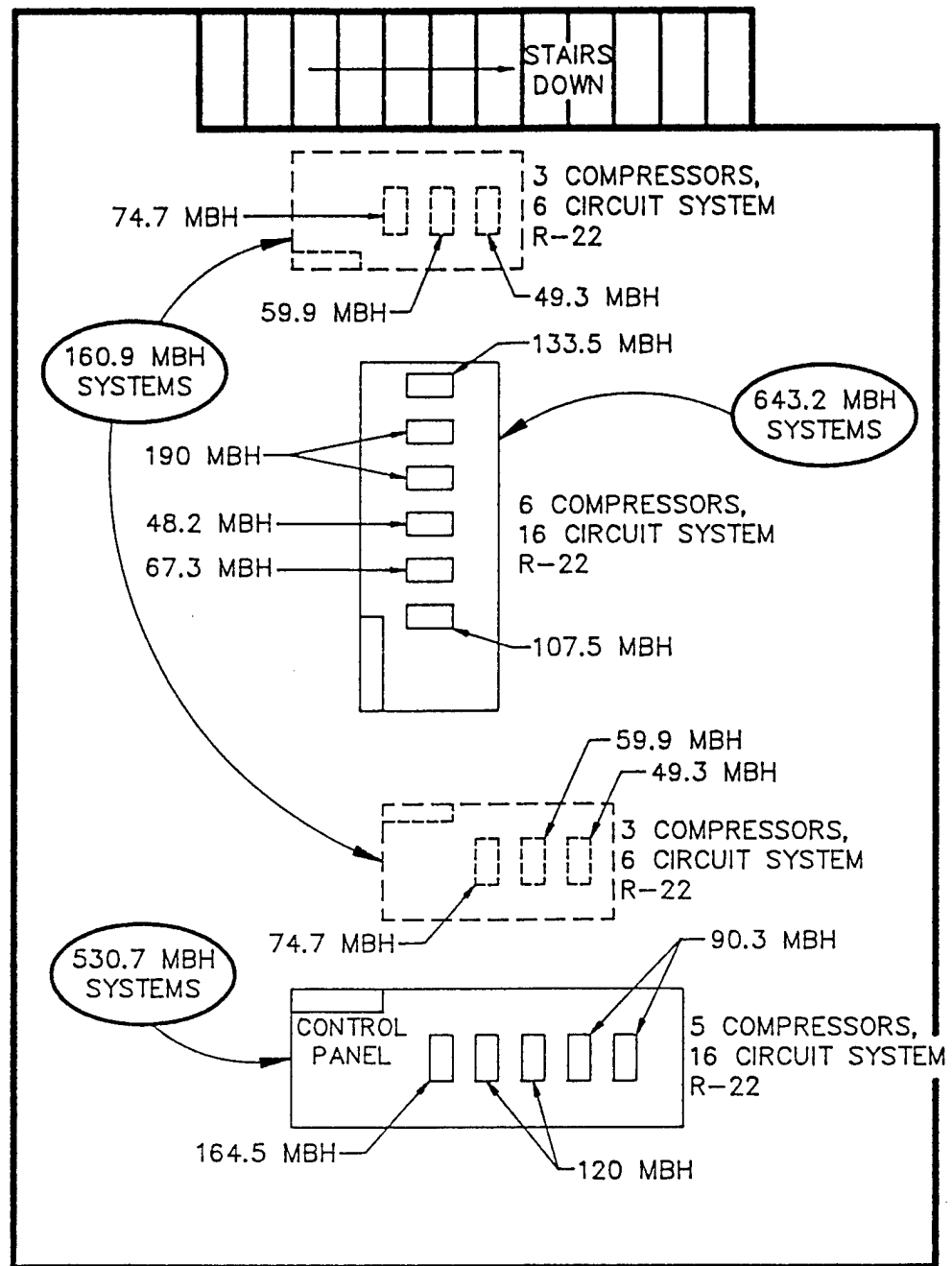


FIGURE 10.3.3.2 - COMMISSARY REFRIGERATION EQUIPMENT LAYOUT

NOTE: TWO SYSTEMS SHOWN DASHED ARE NOT YET IN PLACE AT TIME OF SURVEY BUT ARE BEING INSTALLED IN THE NEXT WEEK OR TWO, TO REPLACE ALL EXISTING SYSTEMS NOT SHOWN.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO3

LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FT. CAMPBELL REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: 003-2702 HEAT RECOVERY

FISCAL YEAR 1994 DISCRETE PORTION NAME: HEAT RECOVERY

ANALYSIS DATE: 09-03-93 ECONOMIC LIFE 20 YEARS PREPARED BY: KEITH DERRIN

1. INVESTMENT

A. CONSTRUCTION COST	\$	17490.	
B. SIOH	\$	875.	
C. DESIGN COST	\$	875.	
D. TOTAL COST (1A+1B+1C)	\$	19240.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		19240.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 6.18	137.	\$ 847.	14.65	\$ 12404.
B. DIST	\$.00	0.	\$ 0.	17.70	\$ 0.
C. RESID	\$.00	0.	\$ 0.	20.99	\$ 0.
D. NAT G	\$ 4.00	161.	\$ 644.	20.60	\$ 13266.
E. COAL	\$.00	0.	\$ 0.	16.32	\$ 0.
F. PPG	\$.00	0.	\$ 0.	13.59	\$ 0.
M. DEMAND SAVINGS			\$ 742.	13.59	\$ 10084.
N. TOTAL		298.	\$ 2233.		\$ 35754.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	0.
(1) DISCOUNT FACTOR (TABLE A)		13.59	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 0.

4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS\ ECONOMIC\ LIFE))$ \$ 2233.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.62 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 35754.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 1.86
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.27 %

ECO - REFRIGERANT HEAT RECLAIM - COMMISSARY REFRIGERATION EQUIPMENT

CALCULATIONS:

Using the pressure - enthalpy diagram for Refrigerant 22 shown in *Figure 1*, the refrigeration cycle for each of the four new refrigeration equipment systems was plotted utilizing the manufacturer's design data for each system. In this way the pressure, temperature and enthalpy were known for each point in the refrigeration cycle, and thus the amount of recoverable heat could be determined. First, the mass flow rate of Refrigerant 22 in each system is determined by the equation:

$$\dot{M} = \dot{Q} / \Delta h$$

where:

\dot{M} = mass flow of refrigerant ($\frac{\text{lbm}}{\text{hr}}$)

\dot{Q} = heat transfer flow rate ($\frac{\text{Btu}}{\text{hr}}$)

Δh = change in enthalpy ($\frac{\text{Btu}}{\text{lbm}}$)

For the two systems with a maximum load of $1160.0 \times 10^3 \frac{\text{Btu}}{\text{hr}}$

$$\dot{M} = 160.9 \times 10^3 \frac{\text{Btu}}{\text{lbm}} / (102 - 42) \frac{\text{Btu}}{\text{lbm}}$$

$$\dot{M} = 2.68 \times 10^3 \frac{\text{lbm}}{\text{hr}} (\text{R-22})$$

To determine the amount of sensible heat (or superheat) available for reclaim, look at the change in enthalpy from statepoints 2 and 2A;

$$\Delta h_{sh} = h_2 - h_{2A} = 127 - 112 = 15 \frac{\text{Btu}}{\text{lbm}}$$

Similarly, the amount of latent heat available is defined as the change in enthalpy from statepoints 2A and 2:

$$\Delta h_{lh} = h_{2A} - h_3 = 112 - 42 = 70 \frac{\text{Btu}}{\text{lbm}}$$

Thus, the total sensible and latent heat available for recovery in the system is:

$$Q_{sh} = \dot{M} \times \Delta h_{sh} = 2.68 \times 10^3 \frac{\text{lbm}}{\text{hr}} \times 15 \frac{\text{Btu}}{\text{lbm}} = 40.2 \times 10^3 \frac{\text{Btu}}{\text{hr}}$$

$$Q_{lh} = \dot{M} \times \Delta h_{lh} = 2.68 \times 10^3 \frac{\text{Btu}}{\text{hr}} \times 70 \frac{\text{Btu}}{\text{lbm}} = 187.6 \times 10^3 \frac{\text{Btu}}{\text{hr}}$$

However, the amount of recoverable latent heat is limited by the refrigerant temperature at this point in the cycle (110°F). The domestic water is assumed to enter the reclaim heat exchanger at 60°. Realistically, the exit temperature of the water after recovering the latent heat from the refrigerant can be no more than 105°F and refrigerant superheat reclaim will have to supply all heat for raising the domestic water temperature above 105°F. For this reason, the two smaller refrigeration systems (106.9 MBH each) will be used to heat the 140°F domestic water systems within the commissary, and the two larger system's (530.7 and 643.2 MBU) reclaimed heat will be used for the 160°F domestic water systems within the commissary.. The amount of water which can be heated by the two 160.9 MBH systems is limited by the amount of available superheat of the two systems combined. To heat the water from 105°F to 140°F:

$$Q_{sh \text{ Total}} = 2 \text{ systems} \times 40.2 \times 10^3 \frac{\text{Btu}}{\text{hr per system}} = 80.4 \times 10^3 \frac{\text{Btu}}{\text{hr}}$$

Thus, the maximum flow rate of hot water will be:

$$q_{hw} = \frac{Q_{sh \text{ Total}}}{500 (\Delta T)} = \frac{80.4 \times 10^3 \frac{\text{btu}}{\text{hr}}}{500 (140-105)} = 4.6 \frac{\text{gal}}{\text{min}}$$

This flow rate assumes that both refrigeration systems are running at full capacity. Assuming that on average the systems run at about 75% load throughout, the actual flow rate of water will be:

$$q_{hw \text{ actual}} = 4.6 \frac{\text{gal}}{\text{min}} \times 0.75 = 3.5 \frac{\text{gal}}{\text{min}}$$

Thus, the amount of latent heat actually recovered can be found:

$$\begin{aligned} Q_{lh \text{ available}} &= 2 \text{ systems} \times 187.6 \times 10^3 \frac{\text{Btu}}{\text{hr}} \text{ (each system)} \\ &= 375.2 \times 10^3 \frac{\text{Btu}}{\text{hr}} \end{aligned}$$

$$\begin{aligned} Q_{lh \text{ recovered}} &= 500 \times 3.5 \frac{\text{gal}}{\text{min}} (\text{H}_2\text{O}) \times (105-60^\circ\text{F}) \\ &= 70,000 \frac{\text{Btu}}{\text{hr}} \end{aligned}$$

Utilizing the total refrigerant superheat available for reclaim and approximately 20% of the available refrigerant latent heat, the total available heat for reclaim is:

$$\begin{aligned} Q_{\text{reclaimed}} &= 500 (q_{\text{hw}}) \Delta T_{\text{hw}} \\ &= 500 (3.5 \frac{\text{gal}}{\text{min}}) (140-60) ^\circ\text{F} \\ &= 140,000 \frac{\text{Btu}}{\text{hr}} \end{aligned}$$

Use the same methodology for the two larger refrigerant systems (530.7 and 643.2 MBH) except the hot water will be heated from 60°F to 160°F.

For 530.7 MBH system:

$$\dot{M} = 530.7 \text{ MBH} / (107-43) = 8.3 \times 10^3 \frac{\text{lbm}}{\text{hr}} (\text{R-22})$$

$$\Delta h_{\text{sh}} = 125-112 = 13 \frac{\text{Btu}}{\text{lbm}}$$

$$\Delta h_{\text{lh}} = 112 - 43 = 69 \frac{\text{Btu}}{\text{lbm}}$$

$$Q_{\text{sh}} = \dot{M} \times \Delta h_{\text{sh}} = (8.3 \times 10^3) \times 13 = 107.9 \times 10^3 \frac{\text{Btu}}{\text{hr}}$$

$$Q_{\text{lh}} = \dot{M} \times \Delta h_{\text{lh}} = (8.3 \times 10^3) \times 69 = 572.7 \times 10^3 \frac{\text{Btu}}{\text{hr}}$$

This system has an exiting refrigerant temperature of 115°F, therefore the latent heat will heat the water to 110°F. Thus, the ΔT of the water for the sensible heat reclaim will be 160°-110° = 50°F.

$$q_{\text{hw}} = \frac{Q_{\text{sh}}}{500 (\Delta T_{\text{hw}})} \times 0.75 = \frac{107.9 \times 10^3}{500(160-110)} \times 0.75 = 3.2 \text{ gpm}$$

$$\begin{aligned} Q_{\text{reclaimed}} &= 500 (q_{\text{hw}}) \Delta T_{\text{hw}} = 500 (3.2) (100^\circ\text{F}) \\ &= 160,000 \frac{\text{Btu}}{\text{hr}} \end{aligned}$$

For the 643.2 MBH System:

$$q_{hw} = \frac{Q_{ah}}{500 \Delta T_{hw}} \times 0.75 = \frac{128.7 \times 10^3}{500 (160-110)} \times 0.75 = 3.9 \text{ gpm}$$

$$Q_{reclaimed} = 500 (q_{hw}) \Delta T_{hw} = 500 (3.9) (160-60) \\ = 195,000 \frac{\text{Btu}}{\text{hr}}$$

ENERGY CONSERVATION OPPORTUNITY HEAT RECOVERY ANALYSIS

DETERMINATION OF SAVINGS System #1 - 140°F System

ASSUMPTIONS:

1. Hot water temperature = 140°F.
2. Cold water temperature = 60°F.
3. Domestic water heaters use electricity.
4. Hours of usage: 0800 - 1700.
5. Cost of electricity is 0.02114.
6. Water heater storage capacity is 4.2 and 60 gallons respectively.

The 42 gallon water heater supplied two (2) employee bathrooms and one (1) janitorial closet. The 60 gallon water heater supplies two (2) lockerroom and two (2) public restrooms. The table below lists the fixtures and their gallons per day of hot water usage.

<u>HOURS USED</u>	<u># FIXTURES</u>	<u>FIXTURE TYPE</u>	<u>GAL/HR</u>	<u>TOTAL GAL/DAY</u>
0800 - 1700	2	Lavatory	4	36
1600 - 1700	1	Service Sink	30	30
0800 - 1700	16	Lavatory	32	288
1600 - 1700	1	Service Sink	30	30
1600 - 1700	1	Sink	30	30
0900 - 1800	4	Lavatory	32	288
				722 Gal/Day

1. PRESENT ENERGY USAGE

The energy required for heating the water is:

$$Q = mC_p\Delta T$$

$$m = \text{Mass Flow Rate} = 722 \frac{\text{Gal}}{\text{Day}} \times \frac{8.34 \text{ lb}}{\text{Gal}} \times 5 \frac{\text{Day}}{\text{Wk}} \times \frac{52 \text{ Wk}}{\text{Yr}} = 1.56 \times 10^6 \frac{\text{Lb}}{\text{Yr}}$$

$$C_p = \text{Specific heat (Btu/Lb-°F)} = 1.0$$

$$\Delta T = \text{Temperature Difference (°F)} = (140-60)$$

$$Q = (1.56 \times 10^6 \text{ Lb/Yr}) (1 \text{ Btu/Lb} \cdot \text{°F}) = 140^\circ\text{F} - 60^\circ$$

$$Q = 12,525,000 \text{ Btu/Year}$$

ENERGY CONSERVATION OPPORTUNITY HEAT RECOVERY ANALYSIS

Ten percent is added to the yearly usage to account for storage tank and piping losses.

$$Q = 125.25 \times 10^6 \text{ Btu/Year} \times 1.1$$

$$Q = 137.77 \times 10^6 \text{ Btu/Year} = 40366 \text{ KWH/Yr}$$

$$\text{Energy Cost} = 40366 \text{ KWH/YR} \times \$0.02114/\text{KWH} = \$853/\text{Yr}$$

This is also the energy savings, since the heat reclaim system supplies 100% of this system's hot water needs.

Since the hot water demand is greatest during the day, assume that electrical demand savings may be taken into account as well 50% of the time ((6) six months out of (12) twelve):

$$\text{Total KW demand of two (2) water heaters} = 4500 \text{ W} + 6000 \text{ W} = 10.5 \text{ KW}$$

$$\text{Demand Savings} = 10.5 \text{ KW} \times \$11.78/\text{kw/Mo} \times 6 \frac{\text{Mo}}{\text{Yr}} = \$742/\text{Yr}$$

$$\text{Total Savings} = \$853 + \$742 = \$1595/\text{Yr}$$

(SYSTEM 1)

$$\text{Energy Savings} = 137,770,000 \frac{\text{Btu}}{\text{Yr}}$$

(SYSTEM 1)

ENERGY CONSERVATION OPPORTUNITY HEAT RECOVERY ANALYSIS

DETERMINATION OF SAVINGS *System #2 - 160°F System*

ASSUMPTIONS:

1. Hot water temperature = 160°F.
2. Cold water temperature = 60°F.
3. Domestic water heater used - natural gas.
4. Hours of usage: 0800 - 1700.
5. Cost of natural gas is \$4.00/MBtu
6. Water heater storage capacity is 450 gallons.

This water heating system serves meat cutting and produce areas. The table below lists the fixtures and their gallons per day of hot water usage. The attach Graph 1 shows the demand place on the water heater and at what time.

<u>HOURS USED</u>	<u># FIXTURES</u>	<u>FIXTURE TYPE</u>	<u>GAL/HR</u>	<u>TOTAL GAL/DAY</u>
0800-1700	3	Lavatory	6	54
0800 -1700	2	Pantry Sink	20	180
1400 -1700	2	Hose Bibb	60	180
1400 - 1700	1	Sinks	30	90
1400 - 1700	1	Utensil Washer	52	156
				680 Gal/Day

1. PRESENT ENERGY USAGE

The energy required for heating the water is:

$$Q = mC_p\Delta T$$

$$m = \text{Mass Flow rate (Lb/Month)} = 680 \frac{\text{Gal}}{\text{Day}} \times \frac{8.34 \text{ lb}}{\text{Gal}} \times 5 \frac{\text{Day}}{\text{Wk}} \times \frac{52 \text{ Wk}}{\text{Yr}}$$

$$C_p = \text{Specific heat (Btu/Lb - °F)} = 1.0$$

$$\Delta T = \text{Temperature Difference (°F)} = (160 - 60)$$

$$Q = 1.47 \times 10^6 \text{ Lb/Yr (1 Btu/Lb - °F) (160°F - 60°F)}$$

$$Q = 147 \times 10^6 \text{ Btu/Year}$$

ENERGY CONSERVATION OPPORTUNITY HEAT RECOVERY ANALYSIS

Ten percent is added to the yearly usage to account for storage tank and piping losses.

$$Q = 147 \times 10^6 \frac{\text{Btu}}{\text{Yr}} \times 1.10$$

$$Q = 161.7 \times 10^6 \frac{\text{Btu}}{\text{Yr}}$$

$$\text{Energy Cost} = 161.7 \times 10^6 \frac{\text{Btu}}{\text{Yr}} \times \$2.94/\text{MBtu Gas} = \$475/\text{Yr}$$

This is also the energy savings, since the heat reclaim system supplies 100% of the system's water heating needs. Thus the total energy savings for system #2 is :

$$\text{Energy Savings} = 161.7 \times 10^6 \text{ Btu/Yr}$$

And Cost Savings are \$475/Yr

The Total Savings for this ECO (total for Systems #1 and #2) are:

$$\text{Energy Savings} = 137.77 \times 10^6 + 161.7 \times 10^6 = 299.5 \times 10^6 \frac{\text{Btu}}{\text{Yr}}$$

$$\text{Cost Savings} = \$1595 + \$475 = \$2070/\text{Yr}$$

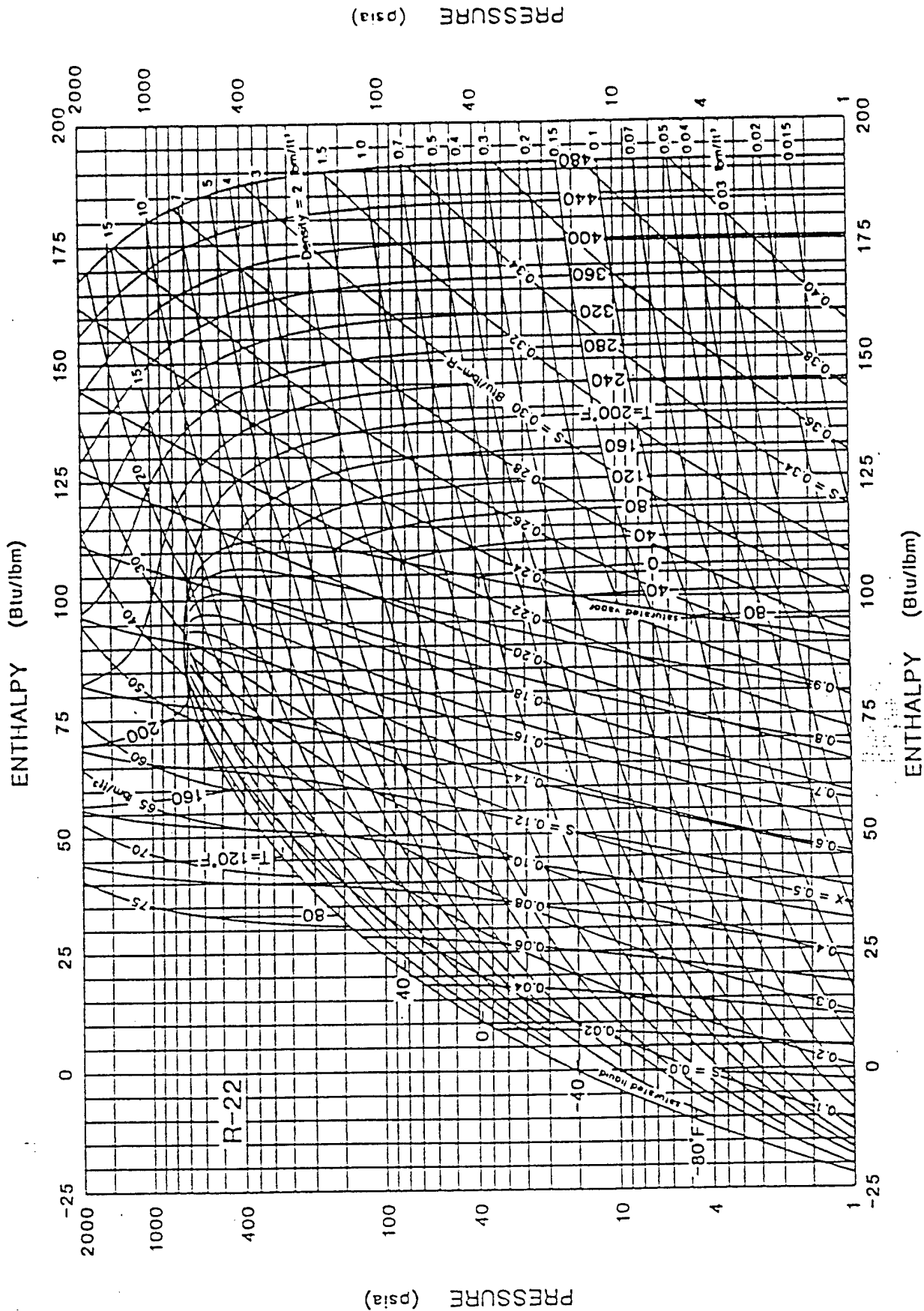
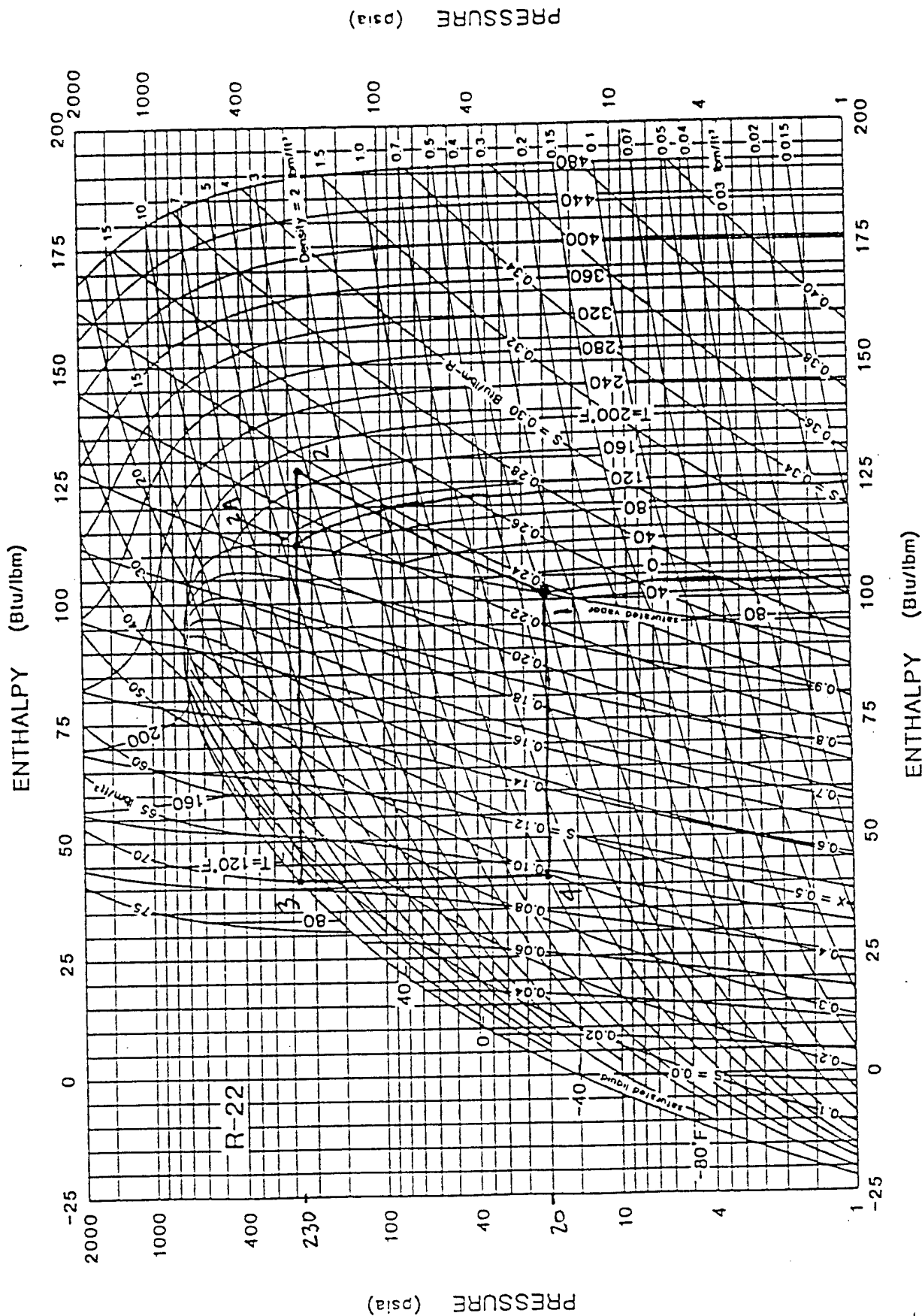


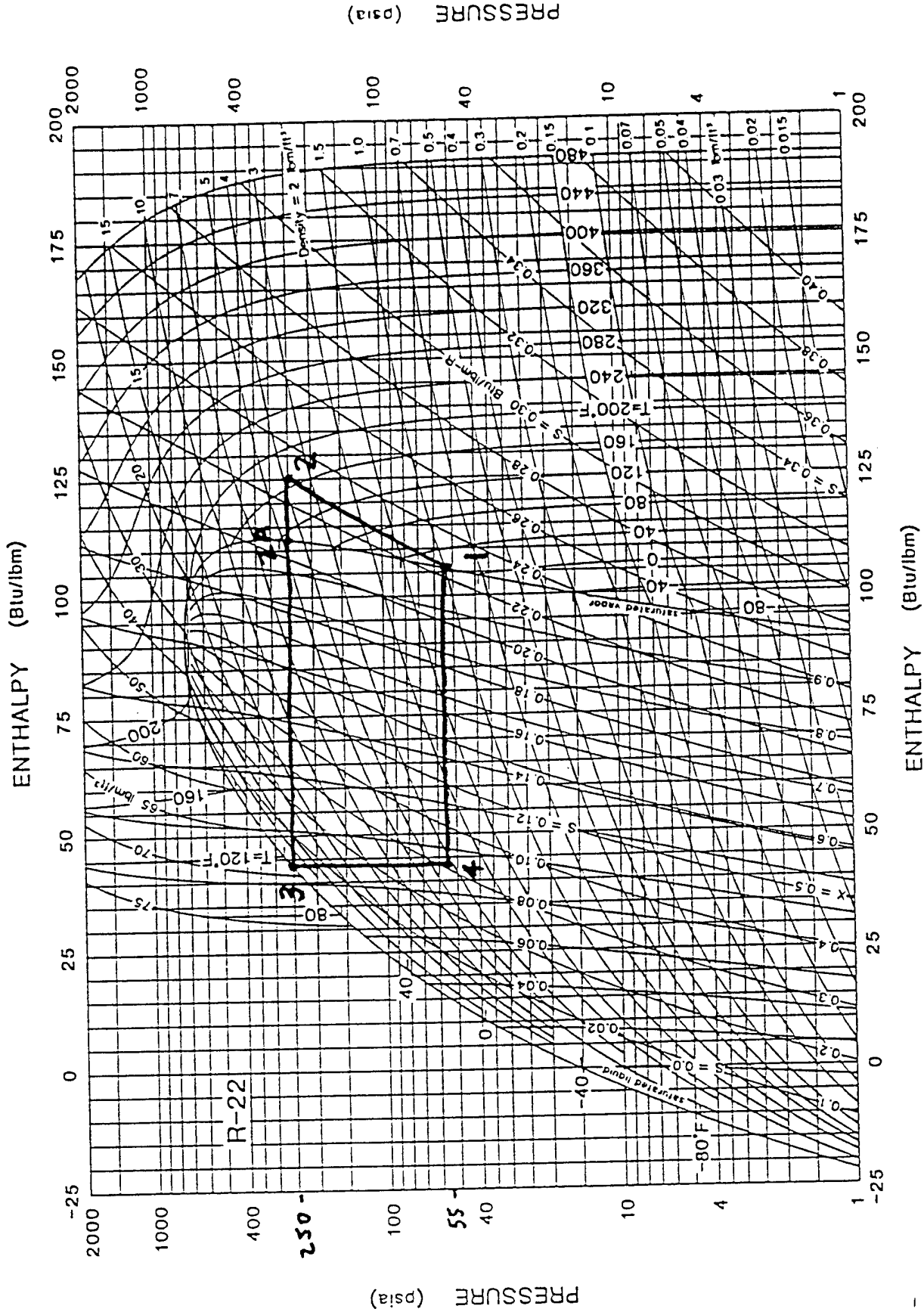
FIGURE 1
Pressure-Enthalpy Diagram for Refrigerant 22

Prepared by: CENTER FOR APPLIED THERMODYNAMIC STUDIES, University of Idaho
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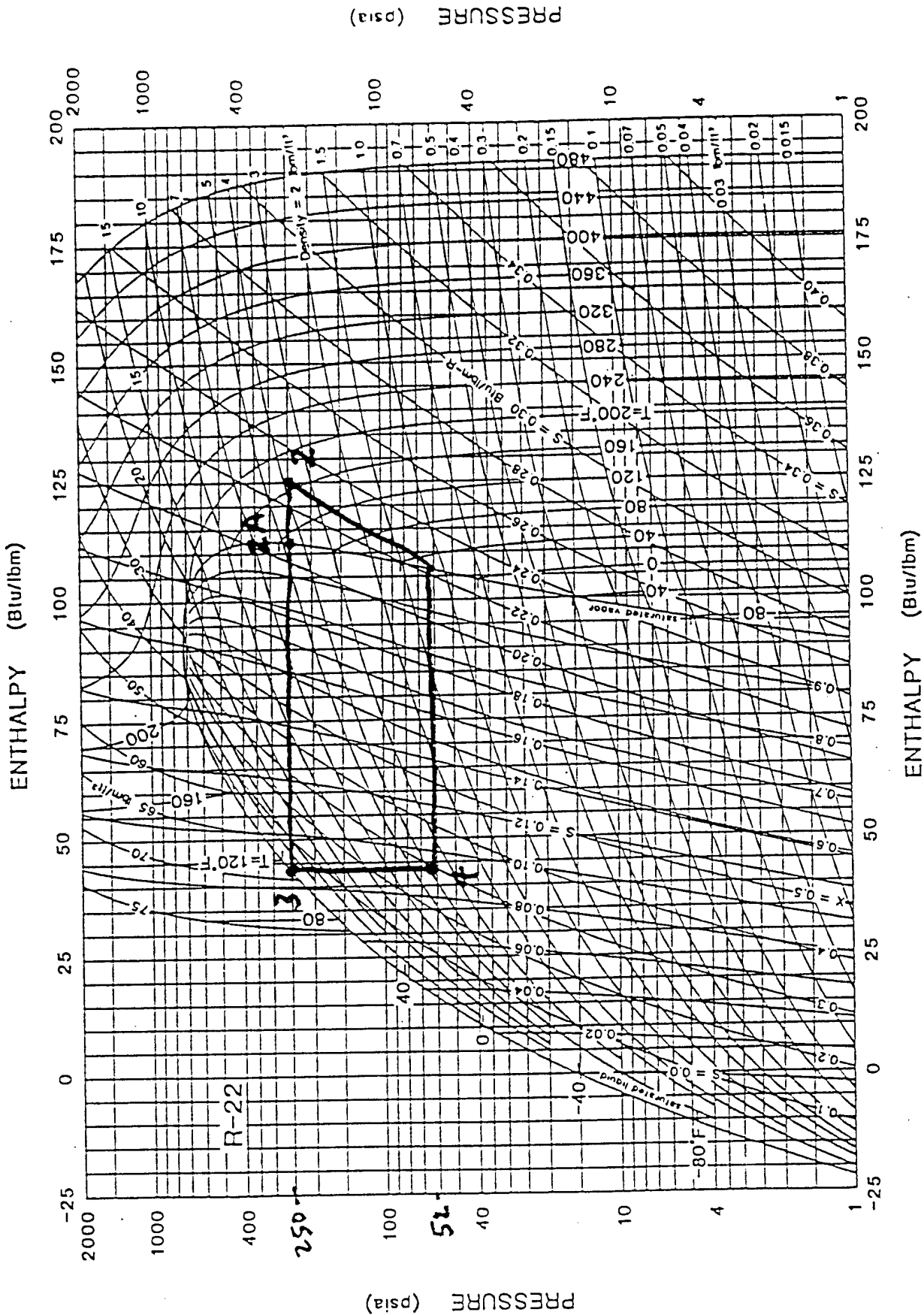
160.9 MBH SYSTEM CYCLE
Pressure-Enthalpy Diagram for Refrigerant 22

Prepared by: CENTER FOR APPLIED THERMODYNAMIC STUDIES, University of Idaho
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530.7 MBH SYSTEM CYCLE Pressure-Enthalpy Diagram for Refrigerant 22



Prepared by: CENTER FOR APPLIED THERMODYNAMIC STUDIES, UNIVERSITY OF MINNAPOLIS
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Fig. 6 Pressure-Enthalpy Diagram for Refrigerant 22

643.2 MBH SYSTEM CYCLE

on 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 10:34:0

TITLE PAGE

ENERGY SAVINGS OPPORTUNITY SURVY
FT CAMPBELL, KY
ECO-3: BUILDING 2702

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: Keith A. Derrington
Estimate Prep. Date: 08/31/93
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N
COMPOSER Plus Copyright (C) 1985, 1988
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Release 4.20

on 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-3: BUILDING 2702

TIME 10:34:01

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DETAILED ESTIMATE

DETAIL PAGE

1. BUILDING TO THE 5 FOOT LINE	
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on 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-3: BUILDING 2702
1. BUILDING TO THE 5 FOOT LINE / AA. MECHANICAL

TIME 10:34:00

DETAILED ESTIMATE

DETAIL PAGE

BASE B

DIVISION 15 MECHANICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT
15650 REFRIGERATION										
15651 REFRIGERATION PIPING SYSTEMS										
SEE CSI 15063 FOR COPPER PIPE AND FITTINGS										
CD=3 HV 0001	PUMP DOWN FOUR REFRIGERATION	*** UNIT COSTS: ***			18.67	497.70	7.91	20.00	1.00	526.6
WC=0900	SYSTEMS, REMOVE PIPING	1.00 EA MSPFI			19	498	8	20	1	51
15670 5000 PUMPS										
CD=3 HV 5003	1/2 HP IN-LINE RECIRCULATING	*** UNIT COSTS: ***			2.86	85.51	1.15	980.00	49.00	1115.6
WC=0900	PUMP	2.00 EA MSPFA			6	171	2	1,960	98	2,25
15700 LIQUID HEAT TRANSFER										
15732 1300 REFRIGERANT TO WATER HEAT RECOVERY HEAT EXCHANGER										
CD=3 HV 1301	40,000 BTU/H DOUBLE WALL,	*** UNIT COSTS: ***			1.67	49.88	0.67	550.00	27.50	628.0
WC=0900	TUBE IN TUBE	2.00 EA MSPFC			3	100	1	1,100	55	1,25
CD=3 HV 1302	160,000 BTU/H DOUBLE WALL,	*** UNIT COSTS: ***			2.50	74.83	1.01	730.00	36.50	842.3
WC=0900	TUBE IN TUBE	1.00 EA MSPFC			3	75	1	730	37	84
CD=3 HV 1303	195,000 BTU/H DOUBLE WALL,	*** UNIT COSTS: ***			2.86	85.51	1.15	825.00	41.25	952.9
WC=0900	TUBE IN TUBE	1.00 EA MSPFC			3	86	1	825	41	95
TOTAL DIVISION 15 MECHANICAL					33	929	14	4,635	232	5,80
TOTAL FACILITY AA. MECHANICAL					33	929	14	4,635	232	5,80

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
 ECO-3: BUILDING 2702
 1. BUILDING TO THE 5 FOOT LINE / BA. PLUMBING

TIME 10:34:

DETAILED ESTIMATE

DETAIL PAGE

BASE B

DIVISION 15 MECHANICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT
15050 BASIC MATERIALS AND METHODS									
15064 5110 PIPE									
CD=4 PL 5113 1 IN.	*** UNIT COSTS: ***			0.06	1.62	0.02	0.29	0.01	1.1
WC=0800	1300.00 LF MPLUC			74	2,109	28	377	19	2,5
15100 1300 BALL VALVES									
CD=3 PL 1301 1" BALL VALVES	*** UNIT COSTS: ***			0.40	12.36	0.10	9.80	0.49	22.1
WC=0800	8.00 EA MPLUC			3	99	1	78	4	18
15100 1600 HOSE BIBS									
CD=3 PL 1601 1" HOSE BIBS	*** UNIT COSTS: ***			0.29	9.06	0.07	5.05	0.25	14.1
WC=0800	8.00 EA MPLUC			2	73	1	40	2	11
15100 1700 CHECK VALVES									
CD=3 PL 1701 1" CHECK VALVE	*** UNIT COSTS: ***			0.35	10.88	0.09	17.15	0.86	28.9
WC=0800	4.00 EA MPLUC			1	44	0	69	3	12
15100 1800 PRESSURE RELIEF VALVES									
CD=3 PL 1801 1" PRESSURE RELIEF VALVE	*** UNIT COSTS: ***			0.28	8.50	0.07	61.00	3.05	72.6
WC=0800	4.00 EA MPLUC			1	34	0	244	12	29
15100 1900 CIRCUIT SETTER VALVES									
CD=3 PL 1901 1/2" CIRCUIT SETTER VALVE	*** UNIT COSTS: ***			0.28	8.50	0.07	31.60	1.58	41.7
WC=0800	4.00 EA MPLUC			1	34	0	126	6	16
15180 INSULATION									
15184 REFRIGERANT PIPING									
CD=3 PL 0001 1 IN DIA. PIPE, 1 IN THICK	*** UNIT COSTS: ***			0.06	2.02	0.02	0.91	0.05	3.0
WC=0800	1300.00 LF AASBC			84	2,631	32	1,183	59	3,90
TOTAL DIVISION 15 MECHANICAL				167	5,023	62	2,118	106	7,30
TOTAL FACILITY BA. PLUMBING				167	5,023	62	2,118	106	7,30
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE				200	5,952	76	6,753	338	13,11
TOTAL BASE BID				200	5,952	76	6,753	338	13,11

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 2702E

6-20

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-3: BUILDING 2702
1. BUILDING TO THE 5 FOOT LINE / BA. PLUMBING

TIME 10:34:0

DETAILED ESTIMATE

DETAIL PAGE

BASE B:

DIVISION 15 MECHANICAL	QUANTITY UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT
TOTAL ADDITIVE			0	0	0	0	0	
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY			200	5,952	76	6,753	338	13,11

* * * END OF DETAIL REPORT * * *

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-3: BUILDING 2702

TIME 10:34:03

PROJECT NOTES

SUMMARY PAGE 1

PROJECT NOTES

ECO-3: HEAT RECLAM FROM HOT REFRIGERANT GAS/CONDENSER UNITS

SCOPE OF WORK: EVALUATE USE OF HEAT RECLAMATION AT COMMISSARY OFF
REFRIGERATION UNTIS.

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-3: BUILDING 2702

TIME 10:34:03

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HONE OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	MECHANICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	5,809	581	0	479	172	0	7,041	7041.23
BA	PLUMBING			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	7,309	731	0	603	216	0	8,859	8858.80
BID ITEM TOTAL		1.00 EA	13,118	1,312	0	1,082	388	0	15,900	15900.03
TOTAL BASE BID			13,118	1,312	0	1,082	388	0	15,900	
TOTAL ADDITIVE			0	0	0	0	0	0	0	
TOTAL INCL ADD			13,118	1,312	0	1,082	388	0	15,900	

Mon 30 Aug 1993

PROJECT CWE SUMMARY

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVEY / FT CAMPBELL, KY
ECO-3: BUILDING 2702

TIME 10:34:0

SUMMARY PAGE

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	15,900		15,900	15900.00
	TOTAL CURRENT CONTRACT COST			15,900	0	15,900	
	Cost Growth from 08/93 to 08/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			15,900	0	15,900	
	Government-Furnished Property			0		0	
	SUBTOTAL			15,900	0	15,900	
	Contingencies	10.0%		1,590	0	1,590	
	SUBTOTAL			17,490	0	17,490	
	SIOH (S&A)	5.0%		875	0	875	
	CURRENT WORKING ESTIMATE			18,365	0	18,365	
	Estimated Construction Time	365	Days				

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-3: BUILDING 2702

TIME 10:34:0

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT **	AMOUNT	PCT	** SUBCON **	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	200	5,952	76	7,090		13,118	100.0%		0		13,118
	TOTAL DIRECT				200	5,952	76	7,090		13,118	100.0%				

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-3: BUILDING 2702

TIME 10:34:0

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE

ID	CONTRACTOR	PH	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT	COS
AA	GENERAL/PRIME		13,118	1,312	10.0%	0.0	1,082	7.5%	2.5%	0.0%	15,900	100.0%	15900.0	
	TOTAL OVERHEAD & PROFIT			1,312	10.0%		1,082	7.5%						

30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-3: BUILDING 2702

TIME 10:34:03

CSI DIVISION SUMMARY

SUMMARY PAGE 6

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
15 MECHANICAL	200	5,952	76	6,753	338	13,118
TOTAL DIRECT	200	5,952	76	6,753	338	13,118

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-3: BUILDING 2702

TIME 10:34:0

SYSTEMS SUMMARY

SUMMARY PAGE

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
08 PLUMBING	167	5,023	62	2,118	106	7,309
09 HEATING, VENTILATION & AIR CONDIT	33	929	14	4,635	232	5,809
TOTAL DIRECT	200	5,952	76	6,753	338	13,118

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-3: BUILDING 2702

TIME 10:34:0

EQUIPMENT SUMMARY

SUMMARY PAGE

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COS
EMI20 SMALL TOOLS								1.40	1.40	54	7
TOTAL PROJECT EQUIPMENT HOURS										54	7

on 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-3: BUILDING 2702

TIME 10:34:0

LABOR SUMMARY

SUMMARY PAGE

CRAFT	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LASBW	ASBESTOS WORKER	20.45	0.0%	24.0%	5.91	0.00	31.27	24.86	84	2,631
LLABR	LABORER/HELPER	17.25	0.0%	24.0%	3.07	0.00	24.46	18.52	35	857
LPLUM	PLUMBERS	21.25	0.0%	24.0%	4.50	0.00	30.85	25.55	54	1,665
LSPFI	STEAM/PIPEFITTERS	20.95	0.0%	24.0%	3.85	0.00	29.83	26.12	28	798
TOTAL PROJECT MANHOURS									200	5,951

*** END OF SUMMARY REPORT ***

7 NAF LIGHTING

The ECO evaluation consisted of determining appropriate lighting replacements to improve lighting system efficiency while achieving recommended illumination levels. The ECO includes comprehensive lighting replacements.

LIGHTING SYSTEM REPLACEMENTS ECO 5	
EXISTING LIGHTING	REPLACEMENT LIGHTING
T-12 Fluorescent Fixture	T-8 Fluorescent Fixture with reflector
T-12 Lamp	T-8 Lamp
Magnetic Ballast	Electronic Ballast
Incandescent Fixture	Compact Fluorescent Fixture
Incandescent Lamp	Compact Fluorescent Lamp and Ballast
Incandescent Exit Sign	LED (Light Emitting Diode) Exit Sign

This section contains the analysis results for the indoor lighting study for facilities classified as non-appropriated funding (NAF). Included in this section are the life cycle cost analysis, energy calculations, and cost estimate for each facility. Please refer to *Section 4* for a detailed description of the ECO.

The life cycle analysis, Sections 3A and 3B, refers to non-energy savings or costs present. For this project, Section 3A, Annual Recurring, reflects maintenance savings available by replacing the existing lighting systems. The new fixtures, due to the use of reflectors, have fewer lamps which saves on material and labor replacement. Compact fluorescents are rated for 10,000 hours versus 750 hours for an incandescent lamp which saves labor for replacements. LED exit signs have similar savings.

Section 3B, Non-Recurring Savings/Costs, refers to the replacement of parts of the existing lighting system. Many fluorescent fixtures surveyed were approaching the end of their economic life. On the spreadsheets included for fluorescent fixture replacement for each building, the higher wattage fixture for each type was replaced in this section. Mercury vapor fixtures were also replaced in 3B due to the termination of their manufacturing in the year 2000.

7 NAF LIGHTING

This section contains the analysis results for the indoor lighting study for facilities classified as non-appropriated funding (NAF). Included in this section are the life cycle cost analysis, energy calculations, and cost estimate for each facility. Please refer to *Section 4* for a detailed description of the ECO.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 91ECO5
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FT. CAMPBELL REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: 005-91 INTERIOR LIGHTING / BUILDING 91

FISCAL YEAR 1994 DISCRETE PORTION NAME: INTERIOR LIGHTING

ANALYSIS DATE: 08-27-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

1. INVESTMENT

A. CONSTRUCTION COST	\$	45861.		
B. SIOH	\$	2293.		
C. DESIGN COST	\$	2293.		
D. TOTAL COST (1A+1B+1C)	\$	50447.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$			50447.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 6.18	203.	\$ 1255.	11.77	\$ 14766.
B. DIST	\$.00	0.	\$ 0.	13.83	\$ 0.
C. RESID	\$.00	0.	\$ 0.	16.15	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	15.34	\$ 0.
E. COAL	\$.00	0.	\$ 0.	12.82	\$ 0.
F. PPG	\$.00	0.	\$ 0.	11.12	\$ 0.
M. DEMAND SAVINGS			\$ 2260.	11.12	\$ 25131.
N. TOTAL		203.	\$ 3515.		\$ 39897.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ 593.
(1) DISCOUNT FACTOR (TABLE A)	11.12	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 6594.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTOR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REPLACE	\$ 28000.	8	.73	20440.
d. TOTAL	\$ 28000.			20440.

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FT. CAMPBELL REGION NOS. 4 CENSUS: 3
 PROJECT NO. & TITLE: 005-91 INTERIOR LIGHTING / BUILDING 91
 FISCAL YEAR 1994 DISCRETE PORTION NAME: INTERIOR LIGHTING
 ANALYSIS DATE: 08-27-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 27034.
 4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$ \$ 5974.
 5. SIMPLE PAYBACK PERIOD (1G/4) 8.44 YEARS
 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 66931.
 7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 1.33
 (IF < 1 PROJECT DOES NOT QUALIFY)
 8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 5.98 %

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 5: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

31 AUGUST 1993

PAGE 1 OF 3

BUILDING WIDE FLUORESCENT FIXTURE REPLACEMENT

BUILDING #: 91

BUILDING USE:

HOURS/DAY 12

DAYS/WEEK 6

ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$11.78 PER KW

EXISTING FIXTURE DATA

4 FOOT

0.1 LAMP @ 48 W/FXT = 0 WATTS
 12.1 LAMP @ 37.8 W/FXT = 453.6 WATTS
 153.2 LAMP @ 96 W/FXT = 14688 WATTS
 0.2 LAMP @ 75.6 W/FXT = 0 WATTS
 0.3 LAMP @ 144 W/FXT = 0 WATTS
 0.3 LAMP @ 113.4 W/FXT = 0 WATTS
 24.4 LAMP @ 192 W/FXT = 4608 WATTS
 35.4 LAMP @ 151.2 W/FXT = 5292 WATTS

REPLACEMENT FIXTURE DATA

4 FOOT

12.1 LAMP @ 37 W/FXT = 444 WATTS
 153.1 LAMP W/ REFLECTORS 37 W/FXT = 5661 WATTS
 0.2 LAMP W/ REFLECTORS 58 W/FXT = 0 WATTS
 59.2 LAMP W/ REFLECTORS 58 W/FXT = 3422 WATTS

2 FOOT

0.1 LAMP @ 31 W/FXT = 0 WATTS
 0.4 LAMP @ 88 W/FXT = 0 WATTS
 0.2 LAMP U @ 96 W/FXT = 0 WATTS
 0.2 LAMP U @ 75.6 W/FXT = 0 WATTS

2 FOOT

0.1 LAMP @ 24 W/FXT = 0 WATTS
 0.2 LAMP W/ REFLECTORS 41 W/FXT = 0 WATTS
 0.2 LAMP U @ 58 W/FXT = 0 WATTS

8 FOOT

0.2 LAMP @ 180 W/FXT = 0 WATTS
 0.2 LAMP @ 168 W/FXT = 0 WATTS

8 FOOT

0.1 LAMP W/ REFLECTORS 58 W/FXT = 0 WATTS

TOTAL EXISTING KW 25.0

TOTAL REPLACEMENT KW 9.5

NET ENERGY SAVINGS 198.2 MBTU/YR

NET DOLLAR SAVINGS \$3,421.10

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 5: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

PAGE 2 OF 3

31 AUGUST 1993

BUILDING WIDE INCANDESCENT LAMP REPLACEMENT

BUILDING #: 91

LAMP USE:

HOURS/DAY 4

DAYS/WEEK 6

PEAK USE 2 (1 - YES, 2 - NO)

ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$0.00 PER KW

EXISTING INCANDESCENTS

0 LAMPS @ 25 WATTS =	0 WATTS
0 LAMPS @ 40 WATTS =	0 WATTS
0 LAMPS @ 52 WATTS =	0 WATTS
6 LAMPS @ 60 WATTS =	360 WATTS
0 LAMPS @ 75 WATTS =	0 WATTS
0 LAMPS @ 90 WATTS =	0 WATTS
0 LAMPS @ 100 WATTS =	0 WATTS

TOTAL EXISTING WATTS 360

COMPACT FLUORESCENT REPLACEMENT

0 LAMPS @ 7 WATTS =	0 WATTS
0 LAMPS @ 9 WATTS =	0 WATTS
6 LAMPS @ 13 WATTS =	78 WATTS
0 LAMPS @ 18 WATTS =	0 WATTS
0 LAMPS @ 26 WATTS =	0 WATTS

TOTAL REPLACEMENT WATTS 78

NET ENERGY SAVINGS 1.20 MBTU/YR

NET DOLLAR SAVINGS \$7.44

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 5: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

31 AUGUST 1993

PAGE 3 OF 3

EXIT SIGN REPLACEMENT -- INCANDESCENT TO LED

BUILDING #: 91

EXIT SIGNS 3

CURRENT WATTAGE 40

REPLACEMENT WATTAGE 3

HOURS/YEAR 8760

ELECTRIC COSTS:
ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$11.78 PER KW

NET ENERGY SAVINGS

3.31 MBTU/YR

NET DOLLAR SAVINGS

\$36.25

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS H-CACES

TIME 09:43:3

TITLE PAGE

ENERGY SAVINGS OPPORTUNITY SURVY
FT CAMPBELL, KY
ECO-5: BUILDING 91

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: Keith A. Derrington
Estimate Prep. Date: 08/31/93
Current UPB/CSI ID: ORL290

H - C A C E S E D I T I O N
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by Building Systems Design, Inc.
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 0091E5
7-7

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 91

TIME 09:43:34

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Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
 ECO-5: BUILDING 91
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 09:43:34

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16500 LIGHTING									
16512 6100 SMALL FL FIXTURES (LESS THAN 40 WATT LAMPS)									
CD=3 EL 6105 SURF SQ W/1 13W BIAXIAL FL LAMP *** UNIT COSTS: ***	1.25				41.26	0.00	27.80	1.39	70.45
WC=1100 WHITE ACRYLIC LENS 6.00 EA EELEA	8				248	0	167	8	423
16512 7000 FLUORESCENT - RECESSED T8 ELECTRONIC BALLAST									
CD=3 EL 7001 4 FT 1 LAMP PARABOLIC LOUVRE *** UNIT COSTS: ***	0.57				18.86	0.07	105.25	5.26	129.45
WC=1100 12.00 EA EELEB	7				226	1	1,263	63	1,553
CD=3 EL 7002 4 FT 1 LAMP PARABOLIC LOUVRE W/ *** UNIT COSTS: ***	0.54				17.84	0.07	122.00	6.10	146.01
WC=1100 REFLECTOR 153.00 EA EELEB	83				2,730	11	18,666	933	22,340
CD=3 EL 7003 4 FT 2 LAMP PARABOLIC LOUVRE W/ *** UNIT COSTS: ***	0.59				19.42	0.08	136.00	6.80	162.29
WC=1100 REFLECTOR 59.00 EA EELEB	35				1,146	4	8,024	401	9,575
16530 1100 SURFACE OR PENDANT MOUNTED									
CD=3 EL 1118 LED EXIT SIGN W/ BATTERY *** UNIT COSTS: ***	1.25				41.26	0.00	121.45	6.07	168.79
WC=1100 3.00 EA EELEA	4				124	0	364	18	506
TOTAL DIVISION 16 ELECTRICAL	136				4,473	16	28,484	1,424	34,398
TOTAL FACILITY AA. ELECTRICAL	136				4,473	16	28,484	1,424	34,398
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE	136				4,473	16	28,484	1,424	34,398
TOTAL BASE BID	136				4,473	16	28,484	1,424	34,398
TOTAL ADDITIVE	0				0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY	136				4,473	16	28,484	1,424	34,398

* * * END OF DETAIL REPORT * * *

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 0091E5

7-9

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 91

TIME 09:43:34

PROJECT NOTES

SUMMARY PAGE 1

PROJECT NOTES

ECO-5: INTERIOR LIGHTING

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY INTERIOR LIGHTING IN
SELECTED FACILITIES AT FT CAMPBELL.

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
 ECO-5: BUILDING 91

TIME 09:43:34

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL	1.00 EA	34,398	10.0% 3,440	0.0% 0	7.5% 2,838	2.5% 1,017	0.0% 0	41,692	41692.25
BID ITEM TOTAL		1.00 EA	34,398	3,440	0	2,838	1,017	0	41,692	41692.25
TOTAL BASE BID			34,398	3,440	0	2,838	1,017	0	41,692	
TOTAL ADDITIVE			0	0	0	0	0	0	0	
TOTAL INCL ADD			34,398	3,440	0	2,838	1,017	0	41,692	

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 91

TIME 09:43:34

PROJECT CWE SUMMARY

SUMMARY PAGE 3

ID BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1. BUILDING TO THE 5 FOOT LINE	1.00 EA	41,692		41,692	41692.20
TOTAL CURRENT CONTRACT COST		41,692	0	41,692	
Cost Growth from 08/93 to 08/94 Index Values: 0000 0000	0.0%	0	0	0	
ESCALATED CONTRACT COST		41,692	0	41,692	
Government-Furnished Property		0		0	
SUBTOTAL		41,692	0	41,692	
Contingencies	10.0%	4,169	0	4,169	
SUBTOTAL		45,861	0	45,861	
SIOH (S&A)	5.0%	2,293	0	2,293	
CURRENT WORKING ESTIMATE		48,154	0	48,154	
Estimated Construction Time	365 Days				

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS H-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 91

TIME 09:43:34

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 4

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	136	4,473	16	29,908	34,398	100.0%	0	34,398
	TOTAL DIRECT				136	4,473	16	29,908	34,398	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 0091E5

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 91

TIME 09:43:34

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PH	SUBTOTAL	*** OVERHEAD *** AMOUNT	PCT	HOFC%	**** PROFIT **** AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT ***** AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		34,398	3,440	10.0%	0.0	2,838	7.5%	2.5%	0.0%	41,692	100.0%	41692.24
	TOTAL OVERHEAD & PROFIT			3,440	10.0%		2,838	7.5%					

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 91

TIME 09:43:34

CSI DIVISION SUMMARY

SUMMARY PAGE 6

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	136	4,473	16	28,484	1,424	34,398
TOTAL DIRECT	136	4,473	16	28,484	1,424	34,398

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 91

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SYSTEMS SUMMARY

SUMMARY PAGE 7

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	136	4,473	16	28,484	1,424	34,398
TOTAL DIRECT	136	4,473	16	28,484	1,424	34,398

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 0091E5

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 91

TIME 09:43:34

EQUIPMENT SUMMARY

SUMMARY PAGE 8

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTH	OWNRSH	EXPENSE	HRLY RATE	UPB RATE	HOURS	TOTAL COST
EMI20 SMALL TOOLS								1.40	1.40	11	16
TOTAL PROJECT EQUIPMENT HOURS										11	16

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 91

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LABOR SUMMARY

SUMMARY PAGE 9

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY -- RATE	UPB RATE	**** TOTAL **** HOURS	COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	136	4,473
TOTAL PROJECT MANHOURS								136	4,473

*** END OF SUMMARY REPORT ***

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 93EC05

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.072

INSTALLATION & LOCATION: FT. CAMPBELL REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: 005-93 INTERIOR LIGHTING / BUILDING 93

FISCAL YEAR 1994 DISCRETE PORTION NAME: INTERIOR LIGHTING

ANALYSIS DATE: 08-27-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

1. INVESTMENT

A. CONSTRUCTION COST	\$	6362.		
B. SIOH	\$	318.		
C. DESIGN COST	\$	318.		
D. TOTAL COST (1A+1B+1C)	\$	6998.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.		
F. PUBLIC UTILITY COMPANY REBATE	\$	0.		
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$			6998.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 6.18	11.	\$ 68.	11.77	\$ 800.
B. DIST	\$.00	0.	\$ 0.	13.83	\$ 0.
C. RESID	\$.00	0.	\$ 0.	16.15	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	15.34	\$ 0.
E. COAL	\$.00	0.	\$ 0.	12.82	\$ 0.
F. PPG	\$.00	0.	\$ 0.	11.12	\$ 0.
M. DEMAND SAVINGS			\$ 443.	11.12	\$ 4926.
N. TOTAL		11.	\$ 511.		\$ 5726.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ 695.
(1) DISCOUNT FACTOR (TABLE A)	11.12	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 7728.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REPLACE	\$ 1700.	8	.73	1241.
d. TOTAL	\$ 1700.			1241.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) STUDY: 93ECO5
INSTALLATION & LOCATION: FT. CAMPBELL REGION NOS. 4 CENSUS: 3 LCCID 1.072
PROJECT NO. & TITLE: 005-93 INTERIOR LIGHTING / BUILDING 93
FISCAL YEAR 1994 DISCRETE PORTION NAME: INTERIOR LIGHTING
ANALYSIS DATE: 08-27-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 8969.
4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$ \$ 1319.
5. SIMPLE PAYBACK PERIOD (1G/4) 5.30 YEARS
6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 14696.
7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 2.10
(IF < 1 PROJECT DOES NOT QUALIFY)
8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 9.27 %

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 5: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

PAGE 1 OF 2

31 AUGUST 1993

BUILDING WIDE FLUORESCENT FIXTURE REPLACEMENT

BUILDING #: 93

BUILDING USE:

HOURS/DAY 7

DAYS/WEEK 7

ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$11.78 PER KW

EXISTING FIXTURE DATA

4 FOOT

0.1 LAMP @ 48 W/FIXT = 0 WATTS
 0.1 LAMP @ 37.8 W/FIXT = 0 WATTS
 2.2 LAMP @ 96 W/FIXT = 192 WATTS
 0.2 LAMP @ 75.6 W/FIXT = 0 WATTS
 0.3 LAMP @ 144 W/FIXT = 0 WATTS
 0.3 LAMP @ 113.4 W/FIXT = 0 WATTS
 0.4 LAMP @ 192 W/FIXT = 0 WATTS
 0.4 LAMP @ 151.2 W/FIXT = 0 WATTS

2 FOOT

0.1 LAMP @ 31 W/FIXT = 0 WATTS
 0.4 LAMP @ 88 W/FIXT = 0 WATTS
 8.2 LAMP U @ 96 W/FIXT = 768 WATTS
 0.2 LAMP U @ 75.6 W/FIXT = 0 WATTS

8 FOOT

0.2 LAMP @ 180 W/FIXT = 0 WATTS
 0.2 LAMP @ 168 W/FIXT = 0 WATTS

TOTAL EXISTING KW

1.0

REPLACEMENT FIXTURE DATA

4 FOOT

0.1 LAMP @ 37 W/FIXT = 0 WATTS
 2.1 LAMP W/ REFLECTORS 37 W/FIXT = 74 WATTS
 0.2 LAMP W/ REFLECTORS 58 W/FIXT = 0 WATTS
 0.2 LAMP W/ REFLECTORS 58 W/FIXT = 0 WATTS

2 FOOT

0.1 LAMP @ 24 W/FIXT = 0 WATTS
 0.2 LAMP W/ REFLECTORS 41 W/FIXT = 0 WATTS
 8.2 LAMP U @ 58 W/FIXT = 464 WATTS

8 FOOT

0.1 LAMP W/ REFLECTORS 58 W/FIXT = 0 WATTS

TOTAL REPLACEMENT KW

0.5

NET ENERGY SAVINGS

3.7 MBTU/YR

NET DOLLAR SAVINGS

\$82.38

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 5: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

31 AUGUST 1993

PAGE 2 OF 2

BUILDING WIDE INCANDESCENT LAMP REPLACEMENT

BUILDING #: 93

LAMP USE:

HOURS/DAY 3

DAYS/WEEK 5

PEAK USE 1 (1 - YES, 2 - NO)

ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$11.78 PER KW

EXISTING INCANDESCENTS

0 LAMPS @ 25 WATTS =	0 WATTS
0 LAMPS @ 40 WATTS =	0 WATTS
0 LAMPS @ 52 WATTS =	0 WATTS
16 LAMPS @ 60 WATTS =	960 WATTS
20 LAMPS @ 75 WATTS =	1500 WATTS
0 LAMPS @ 90 WATTS =	0 WATTS
10 LAMPS @ 100 WATTS =	1000 WATTS
TOTAL EXISTING WATTS	3460

COMPACT FLUORESCENT REPLACEMENT

0 LAMPS @ 7 WATTS =	0 WATTS
0 LAMPS @ 9 WATTS =	0 WATTS
16 LAMPS @ 13 WATTS =	208 WATTS
20 LAMPS @ 18 WATTS =	360 WATTS
10 LAMPS @ 26 WATTS =	260 WATTS
TOTAL REPLACEMENT WATTS	828

NET ENERGY SAVINGS 7.00 MBTU/YR

NET DOLLAR SAVINGS \$415.46

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 09:52:28

TITLE PAGE

ENERGY SAVINGS OPPORTUNITY SURVY
FT CAMPBELL, KY
ECO-5: BUILDING 93

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: Keith A. Derrington
Estimate Prep. Date: 08/31/93
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N
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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 0093E5

7-23

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 93

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DETAILED ESTIMATE	DETAIL PAGE
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AA. ELECTRICAL.....	1

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U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 93
1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 09:52:28

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16500 LIGHTING										
16512 6100 SMALL FL FIXTURES (LESS THAN 40 WATT LAMPS)										
CD=3 EL 6105	SURF SQ W/1 13W BIAXIAL FL LAMP	***	UNIT COSTS: ***	1.25		41.26	0.00	27.80	1.39	70.45
WC=1100	WHITE ACRYLIC LENS	16.00	EA EELEA	20		660	0	445	22	1,127
CD=3 EL 6106	SURF SQ W/1 18W BIAXIAL FL LAMP	***	UNIT COSTS: ***	1.25		41.26	0.00	31.00	1.55	73.81
WC=1100	WHITE ACRYLIC LENS	20.00	EA EELEA	25		825	0	620	31	1,476
CD=3 EL 6107	SURF SQ W/1 26W BIAXIAL FL LAMP	***	UNIT COSTS: ***	1.25		41.26	0.00	31.00	1.55	73.81
WC=1100	WHITE ACRYLIC LENS	10.00	EA EELEA	13		413	0	310	16	738
16512 7000 FLUORESCENT - RECESSED T8 ELECTRONIC BALLAST										
CD=3 EL 7002	4 FT 1 LAMP PARABOLIC LOUVRE W/	***	UNIT COSTS: ***	0.54		17.84	0.07	122.00	6.10	146.01
WC=1100	REFLECTOR	2.00	EA EELEB	1		36	0	244	12	292
CD=3 EL 7006	2 FT 2 LAMP U PARABOLIC LOUVRE	***	UNIT COSTS: ***	0.52		17.19	0.07	119.00	5.95	142.21
WC=1100		8.00	EA EELEB	4		138	1	952	48	1,138
TOTAL DIVISION 16 ELECTRICAL						63	2,071	1	2,571	129 4,771
TOTAL FACILITY AA. ELECTRICAL						63	2,071	1	2,571	129 4,771
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE						63	2,071	1	2,571	129 4,771
TOTAL BASE BID						63	2,071	1	2,571	129 4,771
TOTAL ADDITIVE						0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY						63	2,071	1	2,571	129 4,771

* * * END OF DETAIL REPORT * * *

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 93

TIME 09:52:2

PROJECT NOTES

SUMMARY PAGE

PROJECT NOTES

ECO-5: INTERIOR LIGHTING

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY INTERIOR LIGHTING IN
SELECTED FACILITIES AT FT CAMPBELL.

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 93

TIME 09:52:28

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL		10.0%	0.0%	7.5%	2.5%	0.0%		
	1.00 EA	4,771	477	0	394	141	0	5,783	5783.15
BID ITEM TOTAL	1.00 EA	4,771	477	0	394	141	0	5,783	5783.15
TOTAL BASE BID		4,771	477	0	394	141	0	5,783	
TOTAL ADDITIVE		0	0	0	0	0	0	0	
TOTAL INCL ADD		4,771	477	0	394	141	0	5,783	

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 0093E5

7-27

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
 ECO-5: BUILDING 93

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PROJECT CWE SUMMARY

SUMMARY PAGE 3

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	5,783		5,783	5783.20
	TOTAL CURRENT CONTRACT COST			5,783	0	5,783	
	Cost Growth from 08/93 to 08/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			5,783	0	5,783	
	Government-Furnished Property			0		0	
	SUBTOTAL			5,783	0	5,783	
	Contingencies	10.0%		578	0	578	
	SUBTOTAL			6,362	0	6,362	
	SIOH (S&A)	5.0%		318	0	318	
	CURRENT WORKING ESTIMATE			6,680	0	6,680	

Estimated Construction Time 365 Days

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 93

TIME 09:52:28

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 4

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	** TOTAL DIRECT * AMOUNT PCT	* SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	63	2,071	1	2,699	4,771 100.0%	0	4,771
	TOTAL DIRECT				63	2,071	1	2,699	4,771 100.0%		

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 93

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CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD ***	AMOUNT	PCT	HOFC%	**** PROFIT ****	AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT *****	AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		4,771	477	10.0%	0.0		394	7.5%	2.5%	0.0%		5,783	100.0%		5783.14
	TOTAL OVERHEAD & PROFIT			477	10.0%			394	7.5%							

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 93

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CSI DIVISION SUMMARY

SUMMARY PAGE 6

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	63	2,071	1	2,571	129	4,771
TOTAL DIRECT	63	2,071	1	2,571	129	4,771

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
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SYSTEMS SUMMARY

SUMMARY PAGE 7

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	63	2,071	1	2,571	129	4,771
TOTAL DIRECT	63	2,071	1	2,571	129	4,771

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
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EQUIPMENT SUMMARY

SUMMARY PAGE 8

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	HRLY RATE	UPB RATE	HOURS	TOTAL COST
EMI20 SMALL TOOLS								1.40	1.40	1	1
TOTAL PROJECT EQUIPMENT HOURS										1	1

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 93

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LABOR SUMMARY

SUMMARY PAGE 9

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	63	2,071
TOTAL PROJECT MANHOURS								63	2,071

*** END OF SUMMARY REPORT ***

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 2699EC05

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.072

INSTALLATION & LOCATION: FT. CAMPBELL REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: 005-2699 INTERIOR LIGHTING / BUILDING 2699

FISCAL YEAR 1994 DISCRETE PORTION NAME: INTERIOR LIGHTING

ANALYSIS DATE: 08-27-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

1. INVESTMENT

A. CONSTRUCTION COST	\$	4247.		
B. SIOH	\$	212.		
C. DESIGN COST	\$	212.		
D. TOTAL COST (1A+1B+1C)	\$	4671.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$			4671.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 6.18	39.	\$ 241.	11.77	\$ 2837.
B. DIST	\$.00	0.	\$ 0.	13.83	\$ 0.
C. RESID	\$.00	0.	\$ 0.	16.15	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	15.34	\$ 0.
E. COAL	\$.00	0.	\$ 0.	12.82	\$ 0.
F. PPG	\$.00	0.	\$ 0.	11.12	\$ 0.
M. DEMAND SAVINGS			\$ 380.	11.12	\$ 4226.
N. TOTAL		39.	\$ 621.		\$ 7062.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ 383.
(1) DISCOUNT FACTOR (TABLE A)	11.12	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 4259.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 4259.

4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$ \$ 1004.

5. SIMPLE PAYBACK PERIOD (1G/4) 4.65 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 11321.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= 2.42
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 10.32 %

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 5: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

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31 AUGUST 1993

BUILDING WIDE FLUORESCENT FIXTURE REPLACEMENT

BUILDING #: 2699

BUILDING USE:

HOURS/DAY 12
DAYS/WEEK 7

ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH
DEMAND CHARGE \$11.78 PER KW

EXISTING FIXTURE DATA

4 FOOT
0 1 LAMP @ 48 W/FIXT = 0 WATTS
0 1 LAMP @ 37.8 W/FIXT = 0 WATTS
0 2 LAMP @ 96 W/FIXT = 0 WATTS
0 2 LAMP @ 75.6 W/FIXT = 0 WATTS
0 3 LAMP @ 144 W/FIXT = 0 WATTS
0 3 LAMP @ 113.4 W/FIXT = 0 WATTS
0 4 LAMP @ 192 W/FIXT = 0 WATTS
0 4 LAMP @ 151.2 W/FIXT = 0 WATTS

2 FOOT
0 1 LAMP @ 31 W/FIXT = 0 WATTS
0 4 LAMP @ 88 W/FIXT = 0 WATTS
0 2 LAMP U @ 96 W/FIXT = 0 WATTS
0 2 LAMP U @ 75.6 W/FIXT = 0 WATTS

8 FOOT
0 2 LAMP @ 180 W/FIXT = 0 WATTS
23 2 LAMP @ 168 W/FIXT = 3864 WATTS

TOTAL EXISTING KW

3.9

REPLACEMENT FIXTURE DATA

4 FOOT
0 1 LAMP @ 37 W/FIXT = 0 WATTS
0 1 LAMP W/ REFLECTORS 37 W/FIXT = 0 WATTS
0 2 LAMP W/ REFLECTORS 58 W/FIXT = 0 WATTS
0 2 LAMP W/ REFLECTORS 58 W/FIXT = 0 WATTS

2 FOOT
0 1 LAMP @ 24 W/FIXT = 0 WATTS
0 2 LAMP W/ REFLECTORS 41 W/FIXT = 0 WATTS
0 2 LAMP U @ 58 W/FIXT = 0 WATTS

8 FOOT
23 1 LAMP W/ REFLECTORS 58 W/FIXT = 1334 WATTS

TOTAL REPLACEMENT KW

1.3

NET ENERGY SAVINGS

37.7 MBTU/YR

NET DOLLAR SAVINGS

\$591.26

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 5: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

31 AUGUST 1993

PAGE 2 OF 2

BUILDING WIDE INCANDESCENT LAMP REPLACEMENT

BUILDING #: 2699

LAMP USE:

HOURS/DAY 12

DAYS/WEEK 7

PEAK USE 1 (1-YES, 2-NO)

ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$11.78 PER KW

EXISTING INCANDESCENTS

0 LAMPS @	25 WATTS =	0 WATTS
0 LAMPS @	40 WATTS =	0 WATTS
0 LAMPS @	52 WATTS =	0 WATTS
2 LAMPS @	60 WATTS =	120 WATTS
0 LAMPS @	75 WATTS =	0 WATTS
0 LAMPS @	90 WATTS =	0 WATTS
0 LAMPS @	100 WATTS =	0 WATTS

TOTAL EXISTING WATTS 120

COMPACT FLUORESCENT REPLACEMENT

0 LAMPS @	7 WATTS =	0 WATTS
0 LAMPS @	9 WATTS =	0 WATTS
2 LAMPS @	18 WATTS =	26 WATTS
0 LAMPS @	18 WATTS =	0 WATTS
0 LAMPS @	26 WATTS =	0 WATTS

TOTAL REPLACEMENT WATTS 26

NET ENERGY SAVINGS 1.40 MBTU/YR

NET DOLLAR SAVINGS \$21.97

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 10:10:41

TITLE PAGE

ENERGY SAVINGS OPPORTUNITY SURVY
FT CAMPBELL, KY
ECO-5: BUILDING 2699

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: Keith A. Derrington
Estimate Prep. Date: 08/31/93

Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N
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CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 2699E5
7-38

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 2699

TIME 10:10:42

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DETAILED ESTIMATE	DETAIL PAGE
1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
 ECO-5: BUILDING 2699
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 10:10:47

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL	QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16500 LIGHTING									
16512 6100 SMALL FL FIXTURES (LESS THAN 40 WATT LAMPS)									
CD=3 EL 6105 SURF SQ W/1 13W BIAXIAL FL LAMP *** UNIT COSTS: ***	1.25				41.26	0.00	27.80	1.39	70.45
WC=1100 WHITE ACRYLIC LENS 2.00 EA EELEA	3				83	0	56	3	141
16512 7000 FLUORESCENT - RECESSED T8 ELECTRONIC BALLAST									
CD=3 EL 7007 8 FT 1 LAMP W/ REFLECTOR *** UNIT COSTS: ***	0.54				17.84	0.07	109.00	5.45	132.36
WC=1100 23.00 EA EELEB	12				410	2	2,507	125	3,044
TOTAL DIVISION 16 ELECTRICAL	15				493	2	2,563	128	3,185
TOTAL FACILITY AA. ELECTRICAL	15				493	2	2,563	128	3,185
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE	15				493	2	2,563	128	3,185
TOTAL BASE BID	15				493	2	2,563	128	3,185
TOTAL ADDITIVE	0				0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY	15				493	2	2,563	128	3,185

*** END OF DETAIL REPORT ***

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 2699

TIME 10:10:42

PROJECT NOTES

SUMMARY PAGE 1

PROJECT NOTES

ECO-5: INTERIOR LIGHTING

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY INTERIOR LIGHTING IN
SELECTED FACILITIES AT FT CAMPBELL.

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
 ECO-5: BUILDING 2699

TIME 10:10:42

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST	
AA	ELECTRICAL	1.00 EA	3,185	10.0% 319	0.0% 0	7.5% 263	2.5% 94	0.0% 0	3,861	3860.73
BID ITEM TOTAL		1.00 EA	3,185	319	0	263	94	0	3,861	3860.73
TOTAL BASE BID			3,185	319	0	263	94	0	3,861	
TOTAL ADDITIVE			0	0	0	0	0	0	0	
TOTAL INCL ADD			3,185	319	0	263	94	0	3,861	

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 2699

TIME 10:10:42

PROJECT CWE SUMMARY

SUMMARY PAGE 3

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	3,861		3,861	3860.70
	TOTAL CURRENT CONTRACT COST			3,861	0	3,861	
	Cost Growth from 08/93 to 08/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			3,861	0	3,861	
	Government-Furnished Property			0		0	
	SUBTOTAL			3,861	0	3,861	
	Contingencies	10.0%		386	0	386	
	SUBTOTAL			4,247	0	4,247	
	SIOH (S&A)	5.0%		212	0	212	
	CURRENT WORKING ESTIMATE			4,459	0	4,459	
	Estimated Construction Time	365	Days				

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 2699

TIME 10:10:42

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 4

ID	CONTRACTOR	PH	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT	W/TX	** TOTAL DIRECT * AMOUNT PCT	* SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	15	493	2	2,691		3,185 100.0%	0	3,185
	TOTAL DIRECT				15	493	2	2,691		3,185 100.0%		

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 2699

TIME 10:10:4

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE

ID	CONTRACTOR	PH	SUBTOTAL	*** OVERHEAD ***	AMOUNT	PCT	HOF%	**** PROFIT ****	AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT *****	AMOUNT	PCT	UNIT	COS
AA	GENERAL/PRIME		3,185	319	10.0%	0.0		263	7.5%	2.5%	0.0%		3,861	100.0%		3860.7	
	TOTAL OVERHEAD & PROFIT			319	10.0%			263	7.5%								

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 2699

TIME 10:10:42

CSI DIVISION SUMMARY

SUMMARY PAGE 6

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	15	493	2	2,563	128	3,185
TOTAL DIRECT	15	493	2	2,563	128	3,185

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 2699E5

7-46

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 2699

TIME 10:10:42

SYSTEMS SUMMARY

SUMMARY PAGE 7

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	15	493	2	2,563	128	3,185
TOTAL DIRECT	15	493	2	2,563	128	3,185

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 2699E5

7-47

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 2699

TIME 10:10:42

EQUIPMENT SUMMARY

SUMMARY PAGE 8

----- *** BOOK VALUE ***		ADJ FACTOR		ADJUSTD		BOOK OP --		HRLY ---		UPB		**** TOTAL ****	
EQUIP	DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTH	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST	
EMI20	SMALL TOOLS								1.40	1.40	1	2	
											1	2	
TOTAL PROJECT EQUIPMENT HOURS													

Thu 26 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 2699

TIME 10:10:4

LABOR SUMMARY

SUMMARY PAGE

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	15	493
TOTAL PROJECT MANHOURS								15	493

*** END OF SUMMARY REPORT ***

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 3411ECO5
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FT. CAMPBELL REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: 005-3411 INTERIOR LIGHTING / BUILDING 3411

FISCAL YEAR 1994 DISCRETE PORTION NAME: INTERIOR LIGHTING

ANALYSIS DATE: 09-02-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

1. INVESTMENT

A. CONSTRUCTION COST	\$	16581.		
B. SIOH	\$	829.		
C. DESIGN COST	\$	829.		
D. TOTAL COST (1A+1B+1C)	\$	18239.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				\$ 18239.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 6.18	90.	\$ 556.	11.77	\$ 6546.
B. DIST	\$.00	0.	\$ 0.	13.83	\$ 0.
C. RESID	\$.00	0.	\$ 0.	16.15	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	15.34	\$ 0.
E. COAL	\$.00	0.	\$ 0.	12.82	\$ 0.
F. PPG	\$.00	0.	\$ 0.	11.12	\$ 0.
M. DEMAND SAVINGS			\$ 1470.	11.12	\$ 16346.
N. TOTAL		90.	\$ 2026.		\$ 22893.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ 193.
(1) DISCOUNT FACTOR (TABLE A)	11.12	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 2146.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REPLACE	\$ 8500.	8	.73	6205.
d. TOTAL	\$ 8500.			6205.

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FT. CAMPBELL REGION NOS. 4 CENSUS: 3
 PROJECT NO. & TITLE: 005-3411 INTERIOR LIGHTING / BUILDING 3411
 FISCAL YEAR 1994 DISCRETE PORTION NAME: INTERIOR LIGHTING
 ANALYSIS DATE: 09-02-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

STUDY: 3411ECO5

LCCID 1.072

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$	8351.
4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS\ ECONOMIC\ LIFE))$ \$	2786.
5. SIMPLE PAYBACK PERIOD (1G/4)	6.55 YEARS
6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)	\$ 31244.
7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= (IF < 1 PROJECT DOES NOT QUALIFY)	1.71
8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	7.80 %

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 5: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

PAGE 1 OF 2

31 AUGUST 1993

BUILDING WIDE FLUORESCENT FIXTURE REPLACEMENT

BUILDING #: 3411

BUILDING USE:

HOURS/DAY 9

DAYS/WEEK 5

ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$11.78 PER KW

EXISTING FIXTURE DATA

4 FOOT

0.1 LAMP @ 48 W/FXT = 0 WATTS
 0.1 LAMP @ 37.8 W/FXT = 0 WATTS
 4.2 LAMP @ 96 W/FXT = 384 WATTS
 0.2 LAMP @ 75.6 W/FXT = 0 WATTS
 0.3 LAMP @ 144 W/FXT = 0 WATTS
 0.3 LAMP @ 113.4 W/FXT = 0 WATTS
 26.4 LAMP @ 192 W/FXT = 4992 WATTS
 0.4 LAMP @ 151.2 W/FXT = 0 WATTS

2 FOOT

0.1 LAMP @ 31 W/FXT = 0 WATTS
 0.4 LAMP @ 88 W/FXT = 0 WATTS
 2.2 LAMP U @ 96 W/FXT = 192 WATTS
 0.2 LAMP U @ 75.6 W/FXT = 0 WATTS

8 FOOT

54.2 LAMP @ 180 W/FXT = 9720 WATTS
 0.2 LAMP @ 168 W/FXT = 0 WATTS

TOTAL EXISTING KW 15.3

NET ENERGY SAVINGS 82.9 MBTU/YR

REPLACEMENT FIXTURE DATA

4 FOOT

0.1 LAMP @ 37 W/FXT = 0 WATTS
 4.1 LAMP W/ REFLECTORS 37 W/FXT = 148 WATTS
 0.2 LAMP W/ REFLECTORS 58 W/FXT = 0 WATTS
 26.2 LAMP W/ REFLECTORS 58 W/FXT = 1508 WATTS

2 FOOT

0.1 LAMP @ 24 W/FXT = 0 WATTS
 0.2 LAMP W/ REFLECTORS 41 W/FXT = 0 WATTS
 2.2 LAMP U @ 58 W/FXT = 116 WATTS

8 FOOT

54.1 LAMP W/ REFLECTORS 58 W/FXT = 3132 WATTS

TOTAL REPLACEMENT KW 4.9

NET DOLLAR SAVINGS \$1,981.55

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 5: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

31 AUGUST 1993

PAGE 2 OF 2

OCCUPANCY SENSOR UTILIZATION AFTER LIGHTING RETROFIT

BUILDING #: 3411
 AREA: RESTROOMS
 # OF SENSORS: 3
 HR/DAY 9
 DAY/WEEK 5
 EST HR IN USE/DAY 4.5
 WATTS 1796
 ENERGY SAVINGS 2101 KWH

ELECTRIC COSTS:
 ENERGY CHARGE \$0.0211 PER KWH
 DEMAND CHARGE \$11.78 PER KW

NET ENERGY SAVINGS 7.17 MBTU/YR NET DOLLAR SAVINGS \$44.42

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 12:55:46

TITLE PAGE

ENERGY SAVINGS OPPORTUNITY SURVY
FT CAMPBELL, KY
ECO-5: BUILDING 3411

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: Keith A. Derrington
Estimate Prep. Date: 08/31/93
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N
COMPOSER Plus Copyright (C) 1985, 1988
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Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 3411E5

7-54

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 3411

TIME 12:55:46

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DETAILED ESTIMATE	DETAIL PAGE
1. BUILDING TO THE 5 FOOT LINE	
AA. ELECTRICAL.....	1

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Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 3411
1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 12:55:46

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16500 LIGHTING										
16512 7000 FLUORESCENT - RECESSED T8 ELECTRONIC BALLAST										
CD=3 EL 7002	4 FT 1 LAMP PARABOLIC LOUVRE W/ REFLECTOR	***	UNIT COSTS: ***	0.54	17.84	0.07	122.00	6.10	146.01	
WC=1100		4.00	EA EELEB	2	71	0	488	24	584	
CD=3 EL 7003	4 FT 2 LAMP PARABOLIC LOUVRE W/ REFLECTOR	***	UNIT COSTS: ***	0.59	19.42	0.08	136.00	6.80	162.29	
WC=1100		26.00	EA EELEB	15	505	2	3,536	177	4,220	
CD=3 EL 7006	2 FT 2 LAMP U PARABOLIC LOUVRE	***	UNIT COSTS: ***	0.52	17.19	0.07	119.00	5.95	142.21	
WC=1100		2.00	EA EELEB	1	34	0	238	12	284	
CD=3 EL 7007	8 FT 1 LAMP W/ REFLECTOR	***	UNIT COSTS: ***	0.54	17.84	0.07	109.00	5.45	132.36	
WC=1100		54.00	EA EELEB	29	964	4	5,886	294	7,148	
16900 CONTROLS AND INSTRUMENTATION										
16930 3000 OCCUPANCY SENSORS										
CD=3 EL 3001	OCCUPANCY SENSOR, 1800 W MAX	***	UNIT COSTS: ***	0.50	16.51	0.06	48.00	2.40	66.97	
WC=1100		3.00	EA EELEB	2	50	0	144	7	201	
TOTAL DIVISION 16 ELECTRICAL					49	1,624	6	10,292	515	12,437
TOTAL FACILITY AA. ELECTRICAL					49	1,624	6	10,292	515	12,437
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE					49	1,624	6	10,292	515	12,437
TOTAL BASE BID					49	1,624	6	10,292	515	12,437
TOTAL ADDITIVE					0	0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY					49	1,624	6	10,292	515	12,437

* * * END OF DETAIL REPORT * * *

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 3411E5
7-56

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 3411

TIME 12:55:40

PROJECT NOTES

SUMMARY PAGE 2

PROJECT NOTES

ECO-5: INTERIOR LIGHTING

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY INTERIOR LIGHTING IN
SELECTED FACILITIES AT FT CAMPBELL.

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
 ECO-5: BUILDING 3411

TIME 12:55:46

BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY	COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHER PCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL	1.00 EA	12,437	10.0% 1,244	0.0% 0	7.5% 1,026	2.5% 368	0.0% 0	15,074 15073.95
BID ITEM TOTAL		1.00 EA	12,437	1,244	0	1,026	368	0	15,074 15073.95
TOTAL BASE BID			12,437	1,244	0	1,026	368	0	15,074
TOTAL ADDITIVE			0	0	0	0	0	0	0
TOTAL INCL ADD			12,437	1,244	0	1,026	368	0	15,074

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 3411

TIME 12:55:46

PROJECT CWE SUMMARY

SUMMARY PAGE 3

ID	BID ITEM	QUANTITY	UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1.	BUILDING TO THE 5 FOOT LINE	1.00	EA	15,074		15,074	15073.90
	TOTAL CURRENT CONTRACT COST			15,074	0	15,074	
	Cost Growth from 08/93 to 08/94 Index Values: 0000 0000	0.0%		0	0	0	
	ESCALATED CONTRACT COST			15,074	0	15,074	
	Government-Furnished Property			0		0	
	SUBTOTAL			15,074	0	15,074	
	Contingencies	10.0%		1,507	0	1,507	
	SUBTOTAL			16,581	0	16,581	
	SIOH (S&A)	5.0%		829	0	829	
	CURRENT WORKING ESTIMATE			17,410	0	17,410	

Estimated Construction Time 365 Days

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 3411

TIME 12:55:46

CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 4

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	** TOTAL DIRECT * AMOUNT PCT	* SUBCON * W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	49	1,624	6	10,807	12,437 100.0%	0	12,437
	TOTAL DIRECT				49	1,624	6	10,807	12,437 100.0%		

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 3411

TIME 12:55:46

CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 5

ID	CONTRACTOR	PM	SUBTOTAL	*** OVERHEAD ***	AMOUNT	PCT	HOPC%	**** PROFIT ****	AMOUNT	PCT	BOND%	OTHER%	***** TOTAL CONTRACT *****	AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		12,437	1,244	10.0%	0.0		1,026	7.5%	2.5%	0.0%		15,074	100.0%		15073.95
	TOTAL OVERHEAD & PROFIT			1,244	10.0%			1,026	7.5%							

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 3411

TIME 12:55:46

CSI DIVISION SUMMARY

SUMMARY PAGE 6

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	49	1,624	6	10,292	515	12,437
TOTAL DIRECT	49	1,624	6	10,292	515	12,437

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 3411

TIME 12:55:46

SYSTEMS SUMMARY

SUMMARY PAGE 7

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	49	1,624	6	10,292	515	12,437
TOTAL DIRECT	49	1,624	6	10,292	515	12,437

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 3411

TIME 12:55:46

EQUIPMENT SUMMARY

SUMMARY PAGE 8

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	HRLY RATE	UPB RATE	HOURS	TOTAL COST
ENI20 SMALL TOOLS								1.40	1.40	5	6
TOTAL PROJECT EQUIPMENT HOURS										5	6

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 3411

TIME 12:55:46

LABOR SUMMARY

SUMMARY PAGE 9

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	**** TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	49	1,624
TOTAL PROJECT MANHOURS								49	1,624

* * * END OF SUMMARY REPORT * * *

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 6140ECOS
LCCID 1.072

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FT. CAMPBELL REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: 005-6140 INTERIOR LIGHTING / BUILDING 6140

FISCAL YEAR 1994 DISCRETE PORTION NAME: INTERIOR LIGHTING

ANALYSIS DATE: 09-02-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

1. INVESTMENT

A. CONSTRUCTION COST	\$	6787.		
B. SIOH	\$	339.		
C. DESIGN COST	\$	339.		
D. TOTAL COST (1A+1B+1C)	\$	7465.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.		
F. PUBLIC UTILITY COMPANY REBATE	\$	0.		
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		7465.	

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1992

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 6.18	42.	\$ 260.	11.77	\$ 3055.
B. DIST	\$.00	0.	\$ 0.	13.83	\$ 0.
C. RESID	\$.00	0.	\$ 0.	16.15	\$ 0.
D. NAT G	\$.00	0.	\$ 0.	15.34	\$ 0.
E. COAL	\$.00	0.	\$ 0.	12.82	\$ 0.
F. PPG	\$.00	0.	\$ 0.	11.12	\$ 0.
M. DEMAND SAVINGS			\$ 550.	11.12	\$ 6116.
N. TOTAL		42.	\$ 810.		\$ 9171.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ 207.
(1) DISCOUNT FACTOR (TABLE A)	11.12	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 2302.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-)	YR OC	DISCNT FACTR	DISCOUNTED SAVINGS(+)/ COST(-)(4)
	(1)	(2)	(3)	
1. REPLACE	\$ 5900.	8	.73	4307.
d. TOTAL	\$ 5900.			4307.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FT. CAMPBELL REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 005-6140 INTERIOR LIGHTING / BUILDING 6140
FISCAL YEAR 1994 DISCRETE PORTION NAME: INTERIOR LIGHTING
ANALYSIS DATE: 09-02-93 ECONOMIC LIFE 15 YEARS PREPARED BY: KEITH DERRING

STUDY: 6140ECOS

LCCID 1.072

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$	6609.
4. FIRST YEAR DOLLAR SAVINGS $2N3+3A+(3B1d/(YRS \text{ ECONOMIC LIFE}))$ \$	1410.
5. SIMPLE PAYBACK PERIOD (1G/4)	5.29 YEARS
6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)	\$ 15780.
7. SAVINGS TO INVESTMENT RATIO (SIR)=(5 / 1G)= (IF < 1 PROJECT DOES NOT QUALIFY)	2.11
8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	9.32 %

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 5: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

PAGE 1 OF 2

31 AUGUST 1993

BUILDING WIDE FLUORESCENT FIXTURE REPLACEMENT

BUILDING #: 6140

BUILDING USE:

HOURS/DAY 9

DAYS/WEEK 7

ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$11.78 PER KW

EXISTING FIXTURE DATA

4 FOOT

0.1 LAMP @ 48 W/FIXT = 0 WATTS
 0.1 LAMP @ 37.8 W/FIXT = 0 WATTS
 5.2 LAMP @ 96 W/FIXT = 480 WATTS
 0.2 LAMP @ 75.6 W/FIXT = 0 WATTS
 0.3 LAMP @ 144 W/FIXT = 0 WATTS
 0.3 LAMP @ 113.4 W/FIXT = 0 WATTS
 26.4 LAMP @ 192 W/FIXT = 4992 WATTS
 0.4 LAMP @ 151.2 W/FIXT = 0 WATTS

2 FOOT

0.1 LAMP @ 31 W/FIXT = 0 WATTS
 0.4 LAMP @ 88 W/FIXT = 0 WATTS
 0.2 LAMP U @ 96 W/FIXT = 0 WATTS
 0.2 LAMP U @ 75.6 W/FIXT = 0 WATTS

8 FOOT

0.2 LAMP @ 180 W/FIXT = 0 WATTS
 0.2 LAMP @ 168 W/FIXT = 0 WATTS

TOTAL EXISTING KW

5.5

REPLACEMENT FIXTURE DATA

4 FOOT

0.1 LAMP @ 37 W/FIXT = 0 WATTS
 5.1 LAMP W/ REFLECTORS 37 W/FIXT = 185 WATTS
 0.2 LAMP W/ REFLECTORS 58 W/FIXT = 0 WATTS
 26.2 LAMP W/ REFLECTORS 58 W/FIXT = 1508 WATTS

2 FOOT

0.1 LAMP @ 24 W/FIXT = 0 WATTS
 0.2 LAMP W/ REFLECTORS 41 W/FIXT = 0 WATTS
 0.2 LAMP U @ 58 W/FIXT = 0 WATTS

8 FOOT

0.1 LAMP W/ REFLECTORS 58 W/FIXT = 0 WATTS

TOTAL REPLACEMENT KW

1.7

NET ENERGY SAVINGS

42.2 MBTU/YR

NET DOLLAR SAVINGS

\$795.91

FORT CAMPBELL ENERGY SAVINGS OPPORTUNITY SURVEY

ECO 5: INDOOR/OUTDOOR LIGHTING EFFICIENCIES TO RECOMMENDED LEVELS

31 AUGUST 1993

PAGE 2 OF 2

BUILDING WIDE INCANDESCENT LAMP REPLACEMENT

BUILDING #: 6140

LAMP USE:

HOURS/DAY 3

DAYS/WEEK 7

PEAK USE 2 (1 - YES, 2 - NO)

ELECTRIC COSTS:

ENERGY CHARGE \$0.0211 PER KWH

DEMAND CHARGE \$0.00 PER KW

EXISTING INCANDESCENTS

0 LAMPS @ 25 WATTS =	0 WATTS
0 LAMPS @ 40 WATTS =	0 WATTS
2 LAMPS @ 52 WATTS =	104 WATTS
0 LAMPS @ 60 WATTS =	0 WATTS
0 LAMPS @ 75 WATTS =	0 WATTS
0 LAMPS @ 90 WATTS =	0 WATTS
0 LAMPS @ 100 WATTS =	0 WATTS

TOTAL EXISTING WATTS 104

COMPACT FLUORESCENT REPLACEMENT

0 LAMPS @ 7 WATTS =	0 WATTS
0 LAMPS @ 9 WATTS =	0 WATTS
2 LAMPS @ 13 WATTS =	26 WATTS
0 LAMPS @ 16 WATTS =	0 WATTS
0 LAMPS @ 26 WATTS =	0 WATTS

TOTAL REPLACEMENT WATTS 26

NET ENERGY SAVINGS 0.29 MBTU/YR

NET DOLLAR SAVINGS \$1.80

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES

TIME 13:53:24

TITLE PAGE

ENERGY SAVINGS OPPORTUNITY SURVY
FT CAMPBELL, KY
ECO-5: BUILDING 6140

Contract No: 27-93-C-0096

Prepared By: Systems Corp
Estimator: Keith A. Derrington
Estimate Prep. Date: 08/31/93
Current UPB/CSI ID: ORL290

M - C A C E S E D I T I O N
COMPOSER Plus Copyright (C) 1985, 1988
by Building Systems Design, Inc.
Release 4.20

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6140E5

7-70

Mon 30 Aug 1993

U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 6140

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U.S. ARMY CORPS of ENGINEERS M-CACES
 ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
 ECO-5: BUILDING 6140
 1. BUILDING TO THE 5 FOOT LINE / AA. ELECTRICAL

TIME 13:53:24

DETAILED ESTIMATE

DETAIL PAGE 1

BASE BID

DIVISION 16 ELECTRICAL		QUANTITY	UOM	CREW	MANHR	LABOR	EQUIPMENT	MATERIAL	SALESTX	DIRECT \$
16500 LIGHTING										
16512 6100 SMALL FL FIXTURES (LESS THAN 40 WATT LAMPS)										
CD=3 EL 6105	SURF SQ W/1 13W BIAXIAL FL LAMP *** UNIT COSTS: ***	1.25				41.26	0.00	27.80	1.39	70.45
WC=1100	WHITE ACRYLIC LENS 2.00 EA EELEA	3				83	0	56	3	141
16512 7000 FLUORESCENT - RECESSED T8 ELECTRONIC BALLAST										
CD=3 EL 7002	4 FT 1 LAMP PARABOLIC LOUVRE W/ *** UNIT COSTS: ***	0.54				17.84	0.07	122.00	6.10	146.01
WC=1100	REFLECTOR 5.00 EA EELEB	3				89	0	610	31	730
CD=3 EL 7003	4 FT 2 LAMP PARABOLIC LOUVRE W/ *** UNIT COSTS: ***	0.59				19.42	0.08	136.00	6.80	162.29
WC=1100	REFLECTOR 26.00 EA EELEB	15				505	2	3,536	177	4,220
TOTAL DIVISION 16 ELECTRICAL		20				677	2	4,202	210	5,091
TOTAL FACILITY AA. ELECTRICAL		20				677	2	4,202	210	5,091
TOTAL BID ITEM 1. BUILDING TO THE 5 FOOT LINE		20				677	2	4,202	210	5,091
TOTAL BASE BID		20				677	2	4,202	210	5,091
TOTAL ADDITIVE		0				0	0	0	0	0
TOTAL INCL ADD ENERGY SAVINGS OPPORTUNITY SURVY		20				677	2	4,202	210	5,091

* * * END OF DETAIL REPORT * * *

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ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 6140

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PROJECT NOTES

SUMMARY PAGE 1

PROJECT NOTES

ECO-5: INTERIOR LIGHTING

SCOPE OF WORK: EVALUATE USE OF HIGHER EFFICIENCY INTERIOR LIGHTING IN
SELECTED FACILITIES AT FT CAMPBELL.

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BID ITEM AND FACILITY SUMMARY

SUMMARY PAGE 2

BID ITEM 1 BUILDING TO THE 5 FOOT LINE

BASE BID

ID	FACILITY		COST TO PRM	OVERHEAD	HOME OFC	PROFIT	BOND	OTHR FCTR	TOTAL COST	UNIT COST
AA	ELECTRICAL			10.0%	0.0%	7.5%	2.5%	0.0%		
		1.00 EA	5,091	509	0	420	150	0	6,170	6170.13
BID ITEM TOTAL		1.00 EA	5,091	509	0	420	150	0	6,170	6170.13
TOTAL BASE BID			5,091	509	0	420	150	0	6,170	
TOTAL ADDITIVE			0	0	0	0	0	0	0	
TOTAL INCL ADD			5,091	509	0	420	150	0	6,170	

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PROJECT CWE SUMMARY

SUMMARY PAGE 3

ID BID ITEM	QUANTITY UOM	BASE BID	ADDITIVE	TOTAL COST	UNIT COST
1. BUILDING TO THE 5 FOOT LINE	1.00 EA	6,170		6,170	6170.10
TOTAL CURRENT CONTRACT COST		6,170	0	6,170	
Cost Growth from 08/93 to 08/94 Index Values: 0000 0000	0.0%	0	0	0	
ESCALATED CONTRACT COST		6,170	0	6,170	
Government-Furnished Property		0		0	
SUBTOTAL		6,170	0	6,170	
Contingencies	10.0%	617	0	617	
SUBTOTAL		6,787	0	6,787	
SIOH (S&A)	5.0%	339	0	339	
CURRENT WORKING ESTIMATE		7,126	0	7,126	

Estimated Construction Time 365 Days

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CONTRACTOR DIRECT SUMMARY

SUMMARY PAGE 4

ID	CONTRACTOR	PM	QUANTITY	UOM	MANHRS	LABOR	EQUIPMENT	MAT W/TX	AMOUNT	PCT	W/OH&P	SUBTOTAL
AA	GENERAL/PRIME		1.00	EA	20	677	2	4,412	5,091	100.0%	0	5,091
	TOTAL DIRECT				20	677	2	4,412	5,091	100.0%		

CREW ID: ORL290

CURRENCY in DOLLARS

PROJECT ID: 6140E5

7-76

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U.S. ARMY CORPS of ENGINEERS M-CACES
ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
ECO-5: BUILDING 6140

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CONTRACTOR INDIRECT SUMMARY

SUMMARY PAGE 5

----- *** OVERHEAD *** ----- **** PROFIT **** ----- ***** TOTAL CONTRACT *****													
ID	CONTRACTOR	PM	SUBTOTAL	AMOUNT	PCT	HOFC%	AMOUNT	PCT	BOND%	OTHER%	AMOUNT	PCT	UNIT COST
AA	GENERAL/PRIME		5,091	509	10.0%	0.0	420	7.5%	2.5%	0.0%	6,170	100.0%	6170.13
	TOTAL OVERHEAD & PROFIT			509	10.0%		420	7.5%					

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ENERGY SAVINGS OPPORTUNITY SURVY / FT CAMPBELL, KY
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CSI DIVISION SUMMARY

SUMMARY PAGE 6

ID CSI DIVISION	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
16 ELECTRICAL	20	677	2	4,202	210	5,091
TOTAL DIRECT	20	677	2	4,202	210	5,091

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SYSTEMS SUMMARY

SUMMARY PAGE 7

ID SYSTEM	MANHOURS	LABOR	EQUIPMENT	MATERIAL	SALES TAX	***** TOTAL * DIRECT
11 INTERIOR ELECTRICAL	20	677	2	4,202	210	5,091
TOTAL DIRECT	20	677	2	4,202	210	5,091

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U.S. ARMY CORPS of ENGINEERS M-CACES
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EQUIPMENT SUMMARY

SUMMARY PAGE 8

EQUIP DESCRIPTION	LIFE HRS	TL HRLY	OWNRSH	OWNS	OVTM	OWNRSH	EXPENSE	RATE	RATE	HOURS	COST
EMI20 SMALL TOOLS								1.40	1.40	2	2
TOTAL PROJECT EQUIPMENT HOURS										2	2

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LABOR SUMMARY

SUMMARY PAGE 9

CRAFT DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	HRLY RATE	UPB RATE	**** HOURS	TOTAL COST
LELEC ELECTRICIANS	20.50	0.0%	24.0%	7.49	0.00	32.91	25.79	21	677
TOTAL PROJECT MANHOURS								21	677

* * * END OF SUMMARY REPORT * * *

LOUISVILLE DISTRICT CORPS OF ENGINEERS
ENGINEERING DIVISION, A/E MANAGEMENT BRANCH (CEORL-ED-M)

ANNEX B

DETAILED SCOPE OF WORK

Phase I Basic Contract, & Option Phase II Added ECOs, FORT CAMPBELL, KY
May 10, 1993

1. PROJECT NAME & LOCATION: This is an Energy Savings Opportunity Survey (ESOS), FY93 EEAP at Fort Campbell, KY for various ECOs (Energy Conservation Opportunities) selected in ANNEX A. The Basic Contract award will be for Phase I ECOs prioritized 1 through 5, as selected from ANNEX A, with an Option for Phase II Additional ECOs prioritized 6 through 10 as selected from ANNEX A, and the buildings to be included are listed in Figure B-1.1. The ECOs are summarized as follows:

Phase I- Basic Contract:

1. Instantaneous hot water heater.
77 systems in administrative type facilities-conversion
2. Ground water coupled heat pump.
6 individual family quarters out of 770ea. sampling.
3. Heat reclaim from hot refrigerant gas/condenser units.
1 facility- Commissary for hot gas reclamation.
4. Replace absorption chiller with high efficiency units.
15 chillers- replacements.
5. Indoor/outdoor lighting efficiency to recommended levels.
43 administrative type fac. for indoor/outdoor lighting efficiency. Same fac.'s to be surveyed as in 1. above.
5 family housing areas for street lights.

Phase II- Option, Added ECOs:

6. Reduce indoor, outdoor, or street lighting where illumination exceeds AEI recommended levels.
37 administrative type fac. for indoor/outdoor lighting efficiency. Same fac.'s to be surveyed as in 1. above.
4 family housing areas for street lights.
7. Waste heat recovery-Heat exchanges for ventilation and hot water heat.
15 building locations. Same buildings surveyed as in 1. above.
8. Chiller replacements.
7 chillers in 5 buildings.
9. Variable speed circulation pumps.
57 pumps in barracks (Korean War built).
10. EMCS expansion of buildings and functions.
17 buildings add onto the existing system.

2. GENERAL SOW vs. DETAILED SOW: The General Scope of Work (GSOW) will apply to contract efforts as modified by the Detailed Scope of Work (DSOW). Should conflicts occur between the GSOW and DSOW, the DSOW shall govern.

3. RESPECTIVE POC's for this STUDY:

Louisville District COE- Charles (Chuck) Lockman/CEORL-ED-M
(502) 582-6041, or FAX 6763, or 5281

Fort Campbell, KY DEH- Arlin E. Wright/Supv. Industrial Engr.
DEH-MESB (502) 798-8895, or FAX 9596

Architect/Engineer(A/E)- _____

4. SCOPE:

4.1 The A/E shall provide all work necessary to complete the ESOS as defined in the GSOW including the ANNEX's. Information and instructions contained within the Detailed SOW are provided as a means for the A/E Project Manager (P/M) to expand or modify the GSOW as may be needed to suit the survey for the ESOS ECOs at Fort Campbell, KY.

4.2 The survey will consider all components and aspects of operations of a selection of facilities, replacements, materials, utilities, envelopes, boilers, alternatives methods of equipment, and etc. to determine any energy savings methods/recommendations, energy savings operational methods, systems energy savings requirements, and all operations that could realize energy savings. This could include interviews of various personnel at the installation to accomplish data gathered for quantities, and operational data. Alternate energy sources such as solar, wind, and geothermal, will not be included.

4.3 The survey will consider new designs etc., for energy trends that make each ECO more cost effective and energy saving.

4.4 The A/E shall assist the DEH in arranging for the installation of any metering of various utilities identified in the ECO, such as for electric, gas, etc.

5. DETAILED REQUIREMENTS: All detail requirements selected at Fort Campbell, KY for the purpose of this survey, shall specifically include the special facility and projects identified by the DEH staff. In general the facilities and projects, when investigated relative to the ECO's provided in ANNEX A, shall comprise the bulk of suggestive items normally investigated for the ESOS.

Specific Energy Conservation Opportunities (ECO) Checklist: Each ECO selected from the list in ANNEX A shall be investigated as a minimum, however, if others are found during the investigation that are good candidates they shall also be included and evaluated.

6. PERFORMANCE: The total time required for completion of the ESOS initial award of Phase I shall not be more than 211 calendar days from the date of the Notice to Proceed (NTP) for the contract. Phase II Option award may occur simultaneously with the Phase I award, then the schedule would be required as

printed/scheduled in Figure B-6.1, however, award of Phase II may not occur, and may be scheduled separately on a 175 calendar day basis for completion criteria, from the NTP award. If the ESOs, either Phase I and/or Phase II Option takes the A/E less time than scheduled to achieve, an interim interview meeting at the installation may be coordinated by the A/E with all parties involved in the review process. Figure B-6.1 is a schedule of pertinent events and milestone dates for acceptable performance of the survey at Fort Campbell, KY. Changes or adjustments made to the SOW during the term of the project survey shall be made by the Louisville District.

7. SUBMITTALS: The A/E's Project Manager shall provide direct distribution of all required submittals and documents in the numbers as listed in Figure B-7.1.

8. GOVERNMENT-FURNISHED INFORMATION: The following list of reference documents will be furnished to the A/E:

(1) Final reports of previously completed studies performed under the Energy Engineering Analysis Program (EEAP), See par. 10 for the list.

(2) Latest copies of other energy studies performed since the previous EEAP study, see par. 10 for the list.

(3) Energy Resources Management Plan.

(4) ETLs 1110-3-254, Use of Electric Power for Comfort Space Heating, 1110-3-282, Energy Conservation, 1110-3-318, Procedures for Programming Energy Monitoring and Control Systems (EMCS) Funded through the MCA Program and 1110-3-332, Economic Studies.

(5) Architectural and Engineering Instructions.

(6) Energy Conservation Investment Program (ECIP) Guidance, dated 4 November 1992.

(7) Information on Existing EMCS Studies, Designs, Construction Contracts, or Operating Systems. (Only if needed for this survey)

(8) TM 5-785, Engineering Weather Data, TM 5-800-2, General Criteria Preparation of Cost Estimates, TM 5-800-3, Project Development Brochure, TM 5-815-2, Energy Monitoring and Control Systems (EMCS). TM 5-815-2 need only be furnished if items (7), (10), and (11) are furnished.

(9) AR 415-15, Military Construction Army (MCA) Program Development; AR 415-17, Cost Estimating for Military Programming; AR 415-20, Construction, Project Development and Design Approval; AR 415-28, Department of the Army Facility Classes and Construction Categories; AR 415-35, Construction, Minor Construction; AR 420-10, General Provisions, Organization, Functions, and Personnel; AR 11-27, Army Energy Program; and AR 5-4, Change No. 1, Department of the Army Productivity Improvement Program.

(10) HNDSP-84-076-ED-ME, Preliminary Survey and Feasibility Study for Energy Monitoring and Control Systems. (Only if needed for this study).

(11) CEHND-SP-90-244-ED-ME, EMCS Cost Estimating Guide. (Only if needed for this study).

(12) NCEL CR 82.030, Standardized EMCS Energy Savings Calculations. (Only if needed for this study).

(13) The latest applicable Engineer Improvement Recommendation System (EIRS) bulletin.

(14) An example of a correctly completed implementation document for a project.

8. LCCID, A COMPUTER PROGRAM: A computer program titled Life Cycle Costing in Design (LCCID) is available from the BLAST Support Office in Urbana, IL for a nominal fee. This computer program will be used for performing the economic calculations for ECIP and non-ECIP ECO's. LCCID permits the designer to perform an economic study that conforms to the economic criteria all three services. POC is Linda Lawrie. The A/E is encourage to obtain and use this computer program, because is a universal Government comparison tool that requires comparisons throughout the US for such type surveys and data requirements. The A/E will obtain and use this computer program. The BLAST Support Office can be contacted at 144 Mechanical Engineering Building, 1206 West Green Street, Urbana, IL 61801. The telephone number is (217) 333-3977 or (800) 842-5278. All economic analysis can be performed using simple payback period, however, LCCA will be required for the Government information.

9. SIMULATION PROGRAMS: No computer simulation will be required under this project.

10. LIST OF EEAP REPORTS/STUDIES, FORT CAMPBELL: A review of the following is considered to be of assistance for in the DSOW. The COE and DEH Offices have a copy for review, and/or loan:

- a. Basewide Energy System Plan, Executive Summary, 03/01/83
- b. Basewide Energy System Plan, Vol. 1, & 2, 12/01/82
- c. Energy Consumption & Requirement Survey, 12/01/77
- d. Energy Audit, Dining Facilities, Exec. Summary, 08/01/86
- e. Energy Audit, Dining Facilities, Vol. 1-5, 08/01/86
- f. Limited Energy Study, Cold Stg. Fac., 01/18/93
- g. Energy Efficient Motors, by COE, list of, 11/04/92, sch.comp.5/93

FIGURE B-1.1.1 Listing of Buildings/Facilities/or Areas to be studied in the
ECOs, FORT CAMPBELL, KY:

BASIC CONTRACT, PHASE I:

1. Instantaneous Hot Water Heater- 77 Administrative type fac's:

38	6087	6734	6914
89	6088	6735	6915
91	6137	6736	6916
93	6140	6737	6924
95	6254	6738	6924A
2699	6302	6740	6925
2745	6304	6744	6926
3202	6306	6773	6932
3209	6308	6784	6934
3210	6390	6789	6935
3307	6706	6790	6991
3308	6708	9001	6993
3411	6713	6902	6995
4601	6714	6904	6997
5207	6715	6905	7510
5210	6717	6906	7541
5212	6720	6907	7838
5661	6723	6908	7855
5702	6729	6913	7856
5740			

2. Ground Water Coupled Heat Pump- 6 individual family type quarters:

There are 770 family quarters that currently have heat pumps that need upgrading due to age and limited design characteristics that show up during extreme cold weather conditions. Currently 630 units of same type are being converted to gas package type heating/cooling units. This is a sample study of the 770 units for possible applications as a cross section of various types structures. The locations of areas follows:

<u>Location</u>	<u>Type/Size</u>	<u>Number of Quarters</u>
La Pointe Village (downstairs)	2 bedroom	2-6 Units
La Pointe Village (upstairs)	2 bedroom	2-6 Units
Hammond Heights	4 bedroom	2-4 Units
Drennon Park	4 bedroom	1-2 Units
Drennon Park	4 bedroom	Single Unit

3. Heat Reclaim from Hot Refrigerant Gas/Condenser Units:

1 Facility- Commissary, building 2702

CONTINUED-PHASE I:

4. Replace Absorption Chiller with High Efficiency Units- 15 chillers, size 90-570 tons:

<u>Building Location</u>	<u>Chiller Size</u>
3213	140
3214	250
6711	360
6718	140
6726	360
6732	300
6774	90
6776	320
6781	320
6910	320
6921A	570
6929	320
6936	160
6938	320
6944	380

5. Indoor/Outdoor Lighting Efficiencies to Recommended Levels-

a. 43 Administrative Type Facilities for Indoor Survey
(same facilities to be surveyed as in 1. above):

<u>Location</u>	<u>sq. ft.</u>	<u>Location</u>	<u>sq. ft.</u>
38	16,038	6140	3,867
89	11,545	6254	9,338
91	12,873	6302	5,615
93	17,492	6304	5,385
95	21,864	6306	5,615
2699	3,319	6308	5,385
2745	13,249	6390	12,792
3202	13,381	6708	2,581
3204	2,250	6713	3,610
3206	3,746	6714	2,686
3209	3,598	6715	18,902
3307	2,816	6717	2,581
3308	2,252	6720	4,892
3411	20,918	6723	3,610
5207	169,375	6729	3,610
5212	2,160	7510	14,280
5661	22,480	7514	4,064
5702	14,000	7541	8,904
5740	14,173	7543	998
6087	10,768	7562	1,800
6088	4,988	7574	325
6137	1,440		

b. 5 Family Quarters Areas for Street Lighting Survey:

Hammond Heights
Lee Village
Pierce Village
LaPointe Village
Gardner Village

OPTION, PHASE III:

6. Reduce Indoor, Outdoor, or Street Lighting to Recommended Levels:

a. 37 Administrative Type Facilities for Indoor Survey:

(same facilities to be surveyed as in 1. above)

<u>Location</u>	<u>sq. ft.</u>	<u>Location</u>	<u>sq. ft.</u>
6734	3,610	6913	2,581
6735	2,746	6914	3,610
6736	2,581	6915	3,610
6737	2,581	6916	2,581
6738	2,581	6924	2,581
6740	4,141	6924A	3,688
6744	7,200	6925	3,610
6773	2,581	6926	2,581
6784	2,581	6932	1,000
6789	3,610	6933	3,610
6790	3,610	6934	3,610
6901	9,303	6935	2,581
6902	3,867	6991	3,688
6903	2,686	6993	3,688
6904	2,581	6995	3,688
6905	2,581	6997	3,568
6906	2,581	7855	10,815
6907	2,581	7856	9,607
6908	2,581		

b. 5 Family Quarters Areas for Street Lighting Survey:

Cole Park	Gardner Hills
Drennan Park	Werner Park
Stryker Village	

7. Waste Heat Recovery-Heat Exchanges for Ventilation and Hot Water Heat-15 locations: (Same buildings surveyed in 4. above)

Boilers are in each of these facilities that provide heat in the winter months, also heat for absorption type chiller units in summer months. Excess heat possibly could be recycled by heat exchangers to help make needed hot water as well as heat for ventilation within each boiler facility.

Building location with Boilers

3213	3214	6711	6718
6726	6732	6774	6776
6781	6910	6921A	6929
6936	6938	6944	

8. Chiller Replacements-7 Chillers at 5 Building Locations:

<u>Building Location</u>	<u>Chiller Type/MFG</u>
38	2 units, Carlyne, Carrier
93	2 units, Trane Model #2E5E58NUR2 #2E5F58N

(continued 8., next page)

CONTINUED-PHASE II:

95

1 unit, Worthington Model
#3VHP6

98

2 units, Trane Model
#2E5RG8
#CCUA7506EA

9. Variable Speed Circulation Pumps: Each Korean War Barracks has a circulation pump for heating/cooling water supplied to the fan coil units. There are 49 facilities/pumps in the 6700-6900 block plus an additional 8 facilities in the 3200 block. An ESOS is needed to determine the energy savings by application of variable speed- electronic controls on the pump motors.

10. EMCS Expansion of Buildings and Functions- Adding 17 buildings:

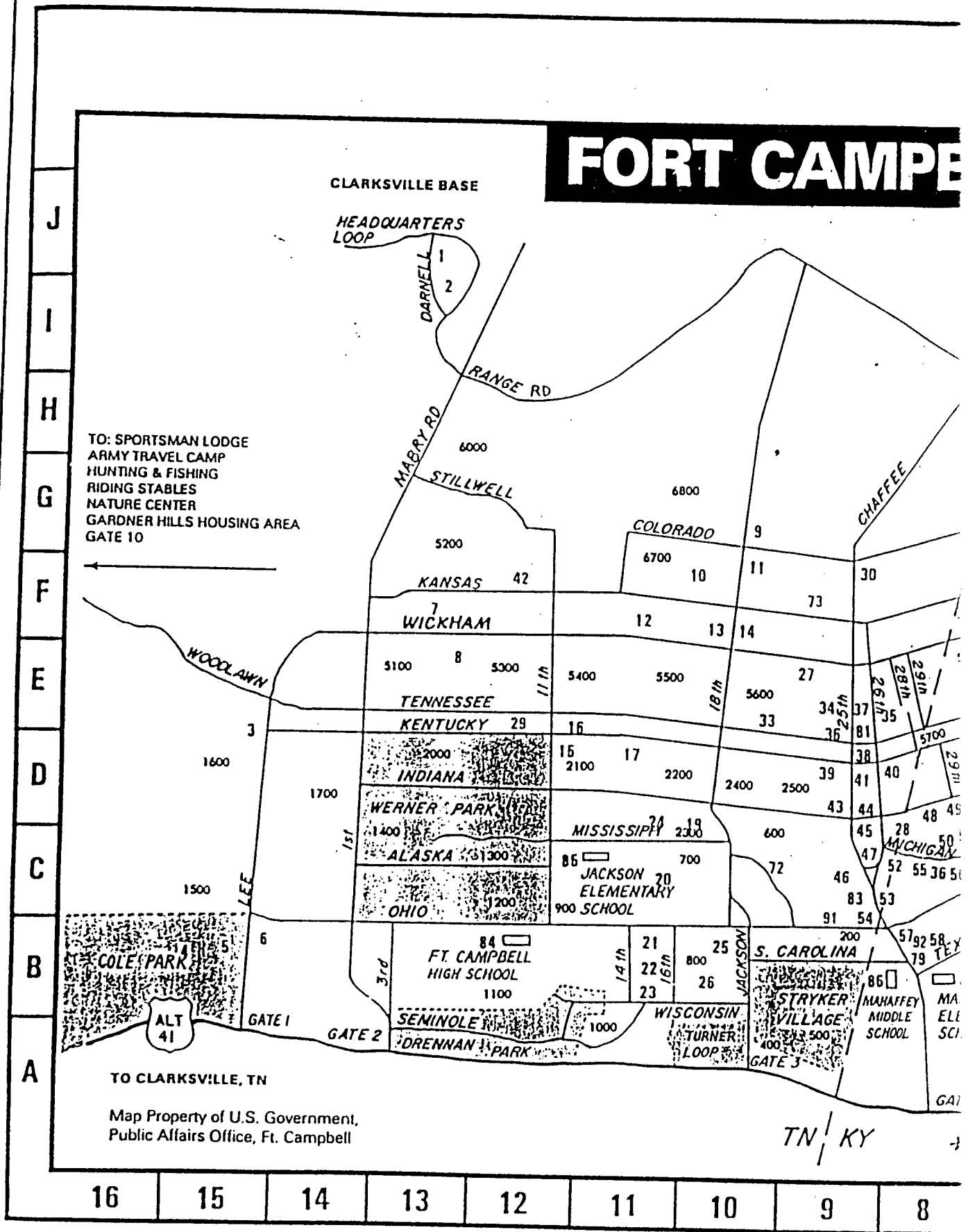
Building Location

80
307
2702
2840
3069
3071
3934
5004
5380

Building Location

6627
6628
6636
6637
7262
7267
7268
7272

FORT CAMPBELL



1

FORT CAMPBELL

LEGEND

ACS Welcome Center (44)
Air Assault Landing Pad (9)
Air Assault School (11)
Army Community Services Center (58)

Auto Craft Shop (14)
Bachelor Enlisted Quarters (65)
Bachelor Officers Quarters (4)
Baldonado Swimming Pool (43)
Bank (51)
Barkley School (90)

F-10
D-7
E-6 & B-15
D-9
D-8
E-3

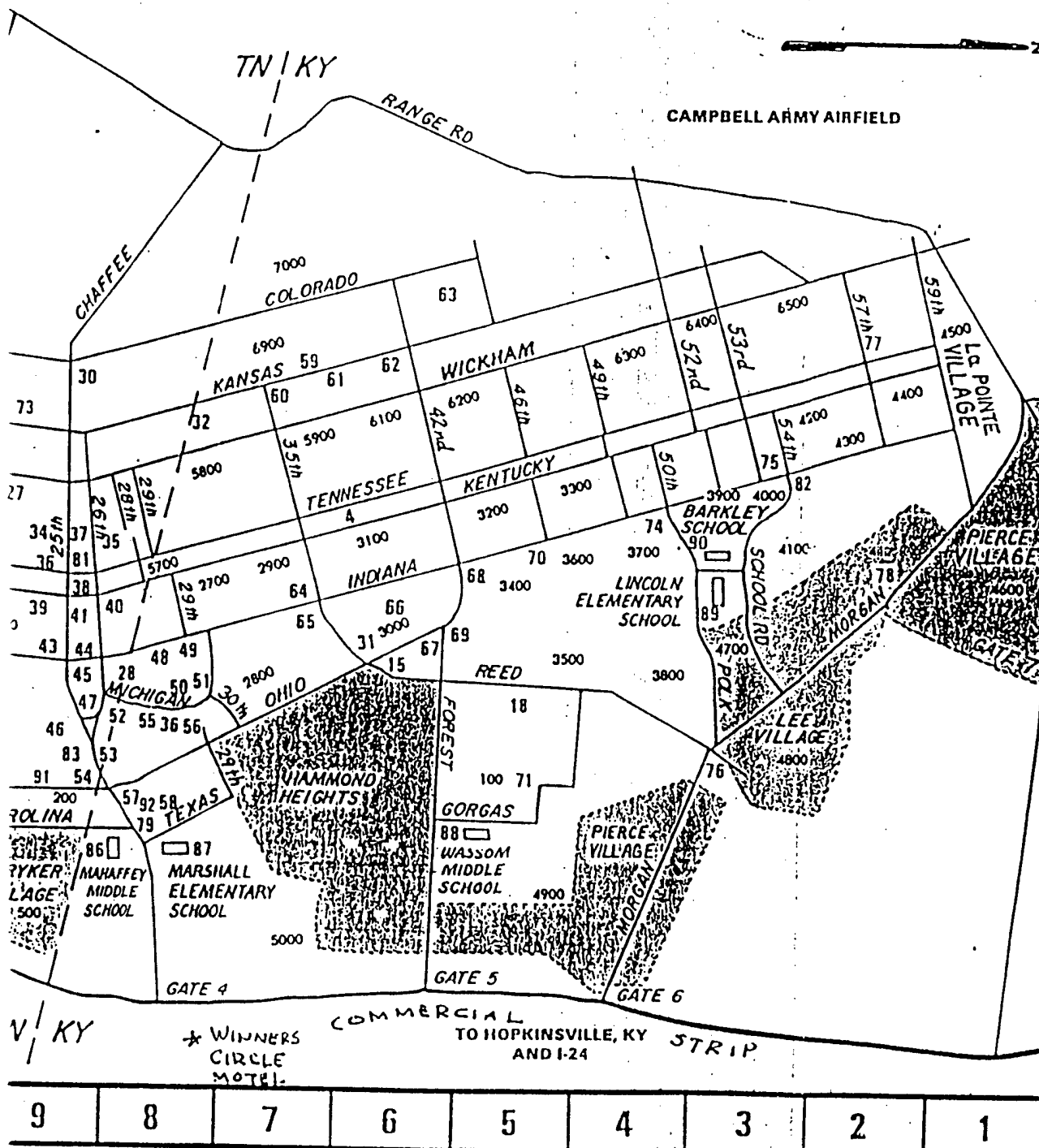
Burger King (37)
Champions Sports Club (8)
Chapels and Chaplain Office
Chaplain Activities Office
Chaplain Activity Center
Hospital Chaplain's Office
Community Chapel (10)
Eagle Chapel (64)
Faith Chapel (63)
Fellowship Chapel (67)
Grace Chapel (70)
Peace Chapel (19)
Hope Chapel (2)
Memorial Chapel (75)
Soldiers Chapel (32)

Civilian Personnel Office (5)
Clarksville Base Physical Fitness
Clarksville Base Swimming Pool
Cole Park Golf Course (3)
Commissary (49)
Community Life Center (76)
Consolidated Supply (7)
Credit Union (28)
Directorate of Information
Division and Post Headquarters
Division Resources Management
Dryer Field House (41)
Eagle Conference Room (48)
Eagles Roost Recreation Center
Estep Physical Fitness Facilities
Engineers Office (2)
Finance and Accounting Office
Fort Campbell High School
Four Seasons/Toyland (23)
Fratellenico Physical Fitness
Fryar Stadium (33)
Gardner Bowling Lanes (69)
Gardner Swimming Pool (10)
Gertsch Physical Fitness Center
Greyhound Bus Station (38)
Guenette Arts & Crafts Center
Hooper Bowling Center (29)
Hospital - Colonel Florence

Army Community Hospital
In-Out Processing Facility (4)
Inspector General (92)
Jackson Elementary School
Kentucky Fried Chicken (31)
Kuhn Dental Clinic (60)
Lee Recreation Center (34)
Lee Village Exchange and Community
Library (46)
Lincoln Elementary School
Lozada Physical Fitness Center
Mahaffey Middle School (86)
Main Post Exchange (50)
Marshall Elementary School
Muldoon Swimming Pool (10)
NCO/Eagle Rendezvous Club
Noncommissioned Officers /
Officers Open Mess (6)
Officers Swimming Pool (5)
Olive Physical Fitness Center
Package Store (26)
Patio Laundromat (81)
Perez Baseball Field (27)
Post Office (55)
Pratt Museum/Wickham Hall
Provost Marshall's Office (54)
Public Affairs Office (79)
Purchasing and Contracting
PX Service Station (36)
Recycling Center (42)
Red Cross Office (83)
Shoppette (15)
Simms Guest House (45)
Single Swimming Pool (62)
Small Animal Clinic (20)
Synthetic Trainer Complex (7)
Taylor Dental Clinic (13)
Thrift Shop (22)
Transportation Division (25)
Vehicle/Weapons Registration
Wassom Middle School (88)
Wayne Recreation Center
Wilson Theater (52)

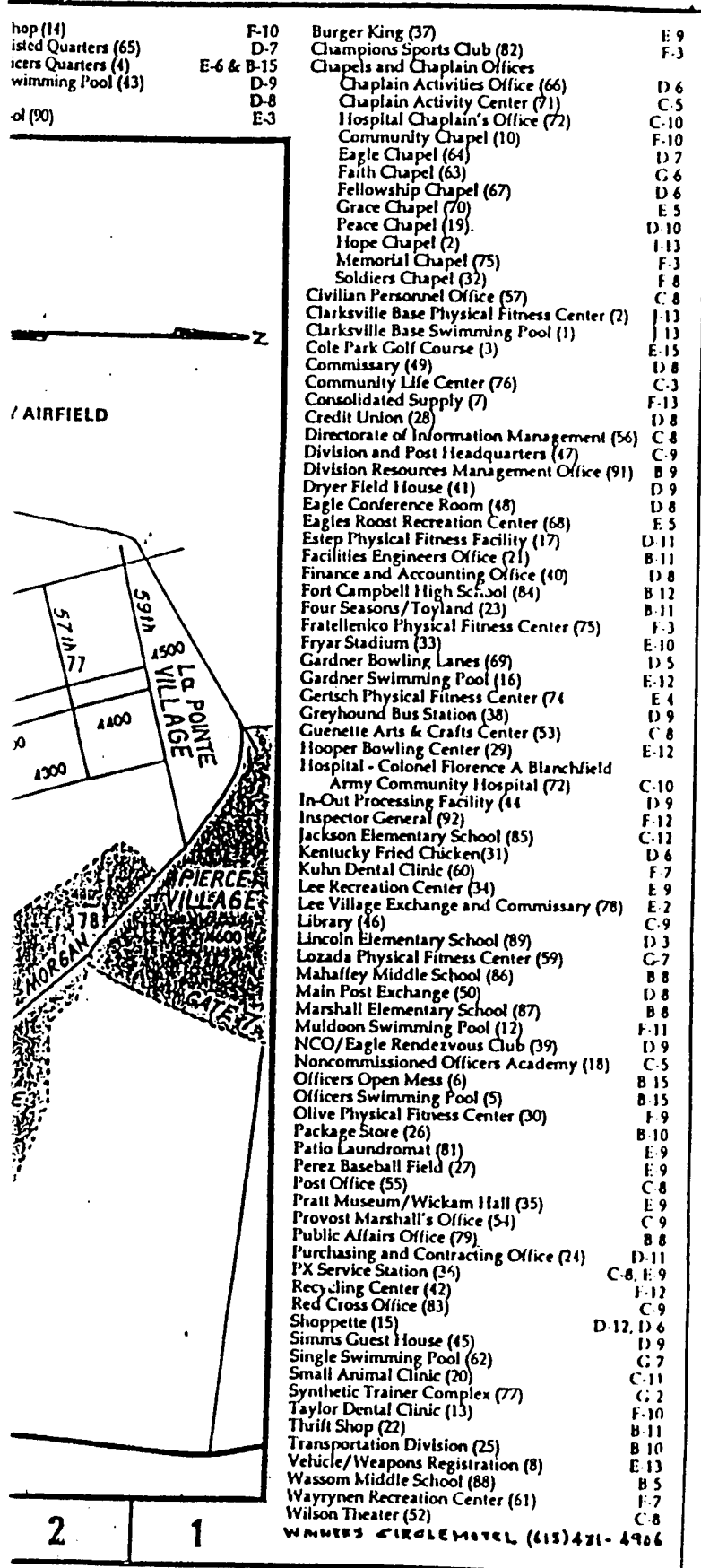
WINNERS CIRCLE MOTEL

FORT CAMPBELL, KY

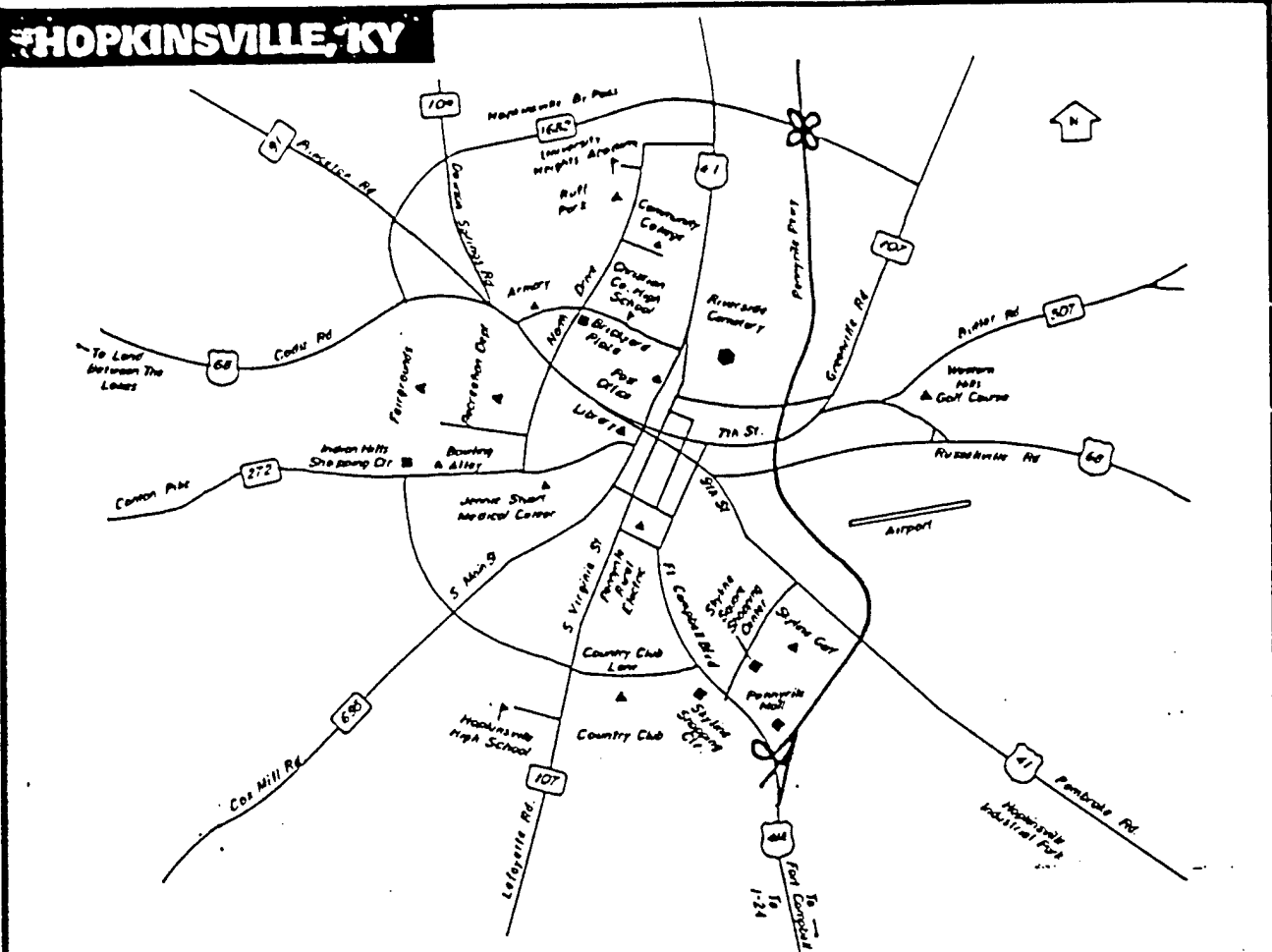
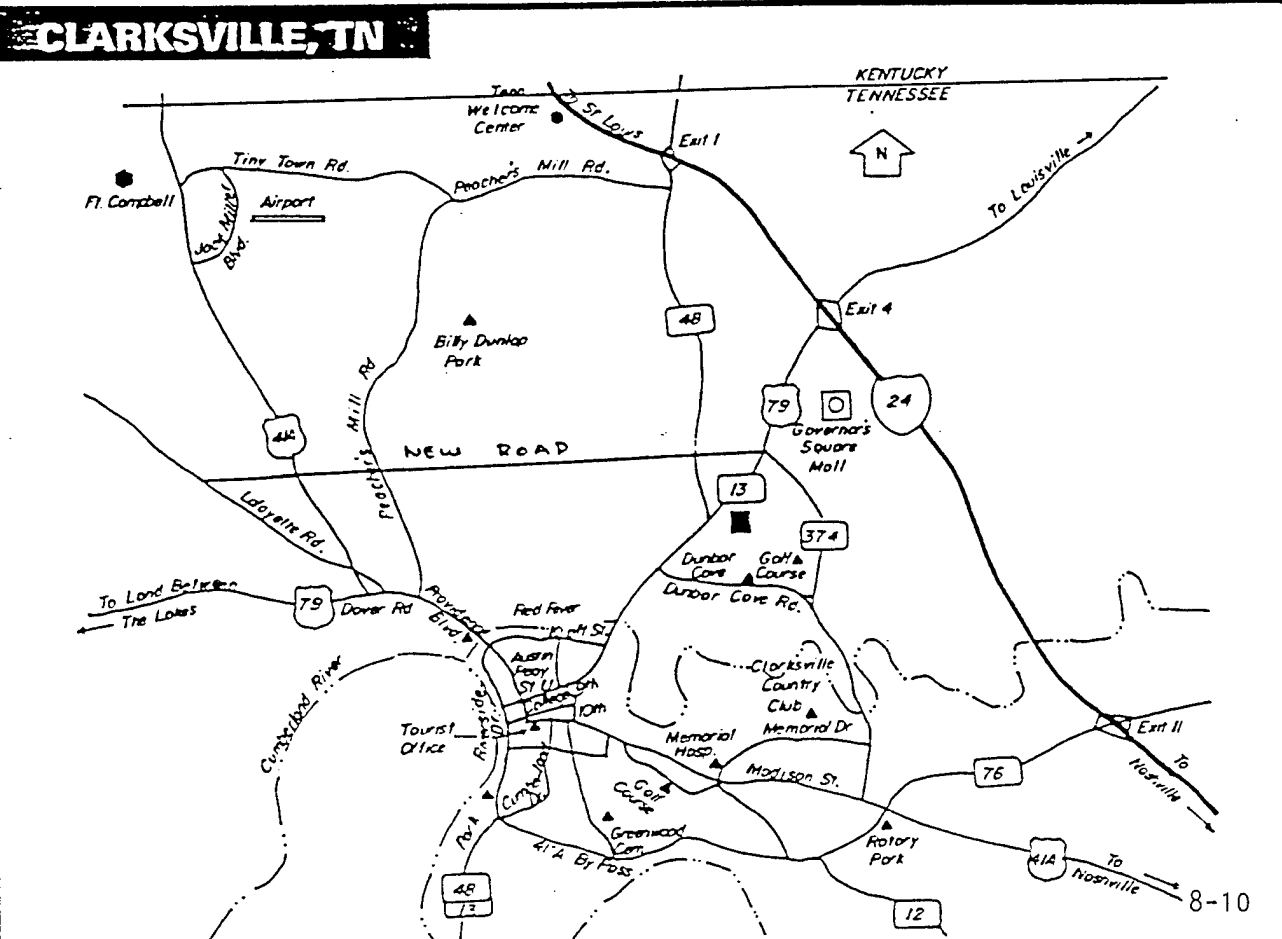


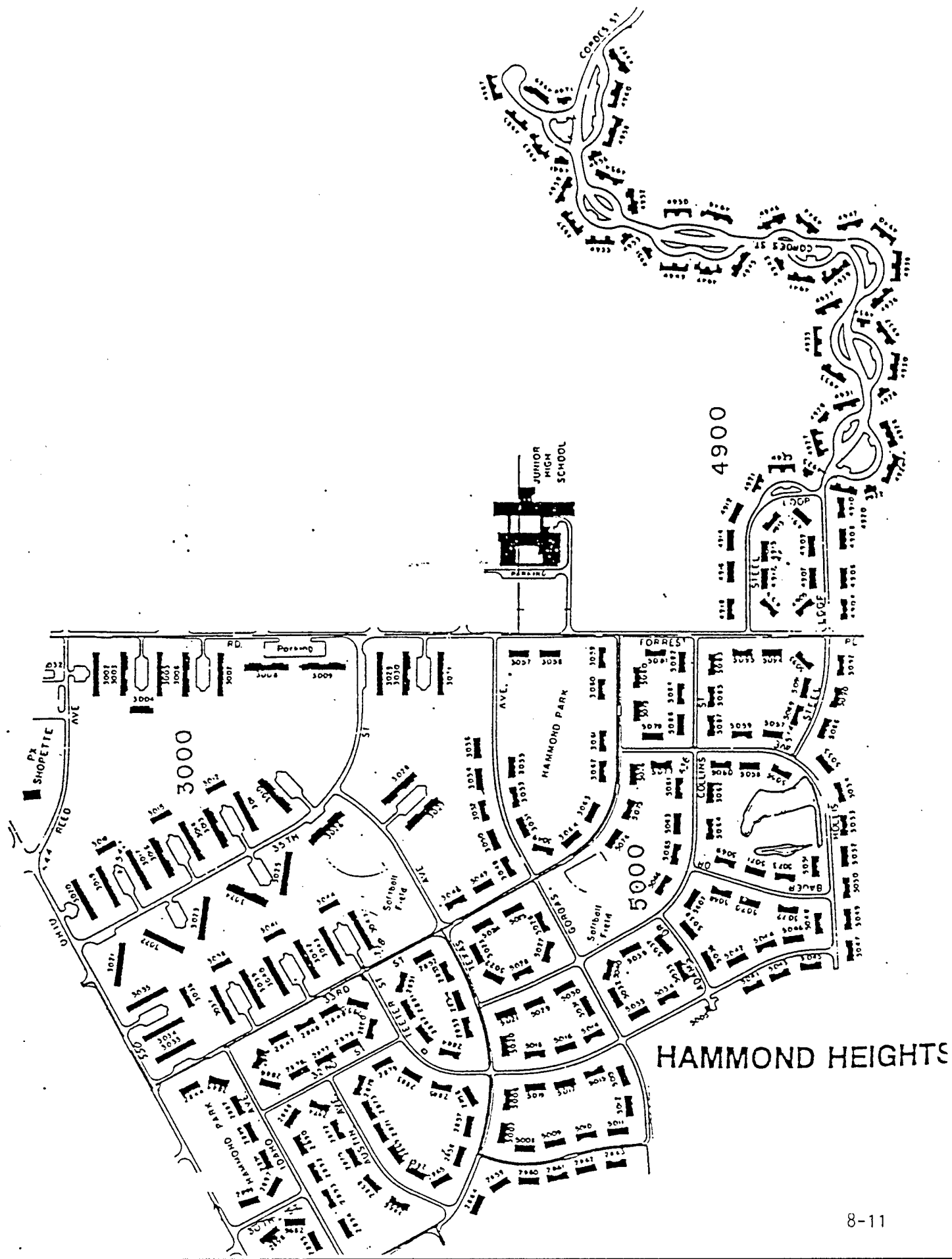
GENERAL LOCATION MAP

FORT CAMPBELL, KY

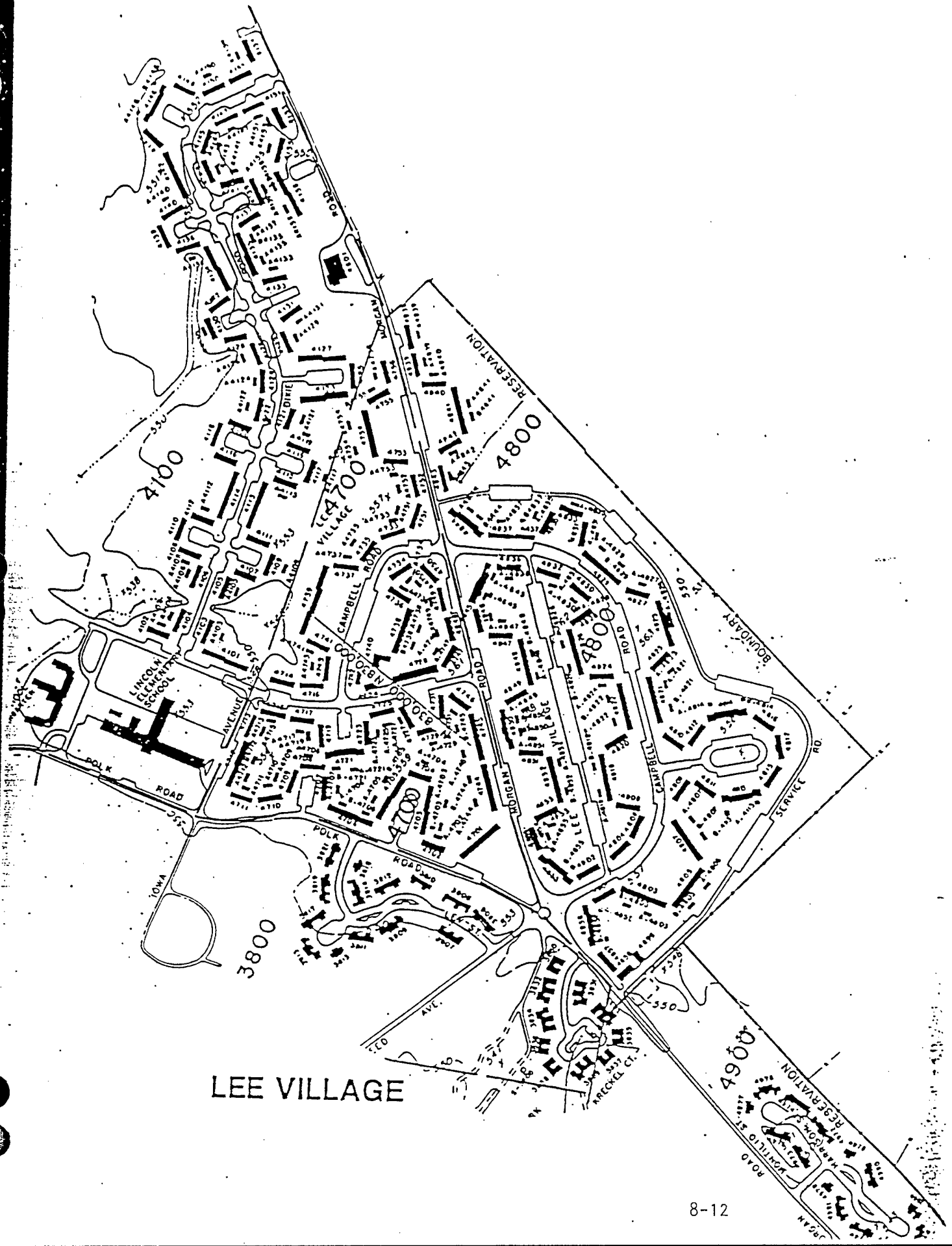


HOPKINSVILLE, KY

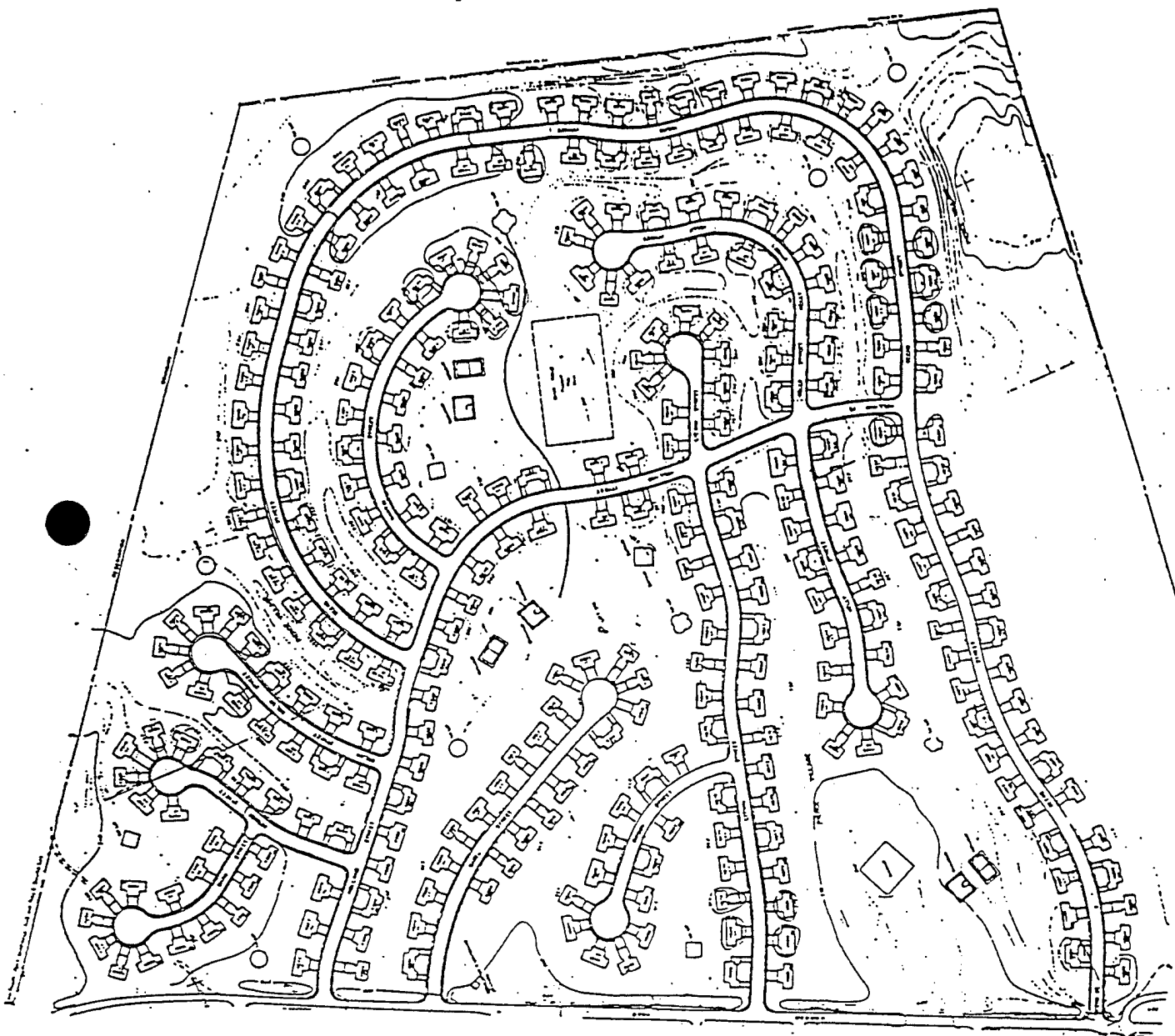
**CLARKSVILLE, TN**



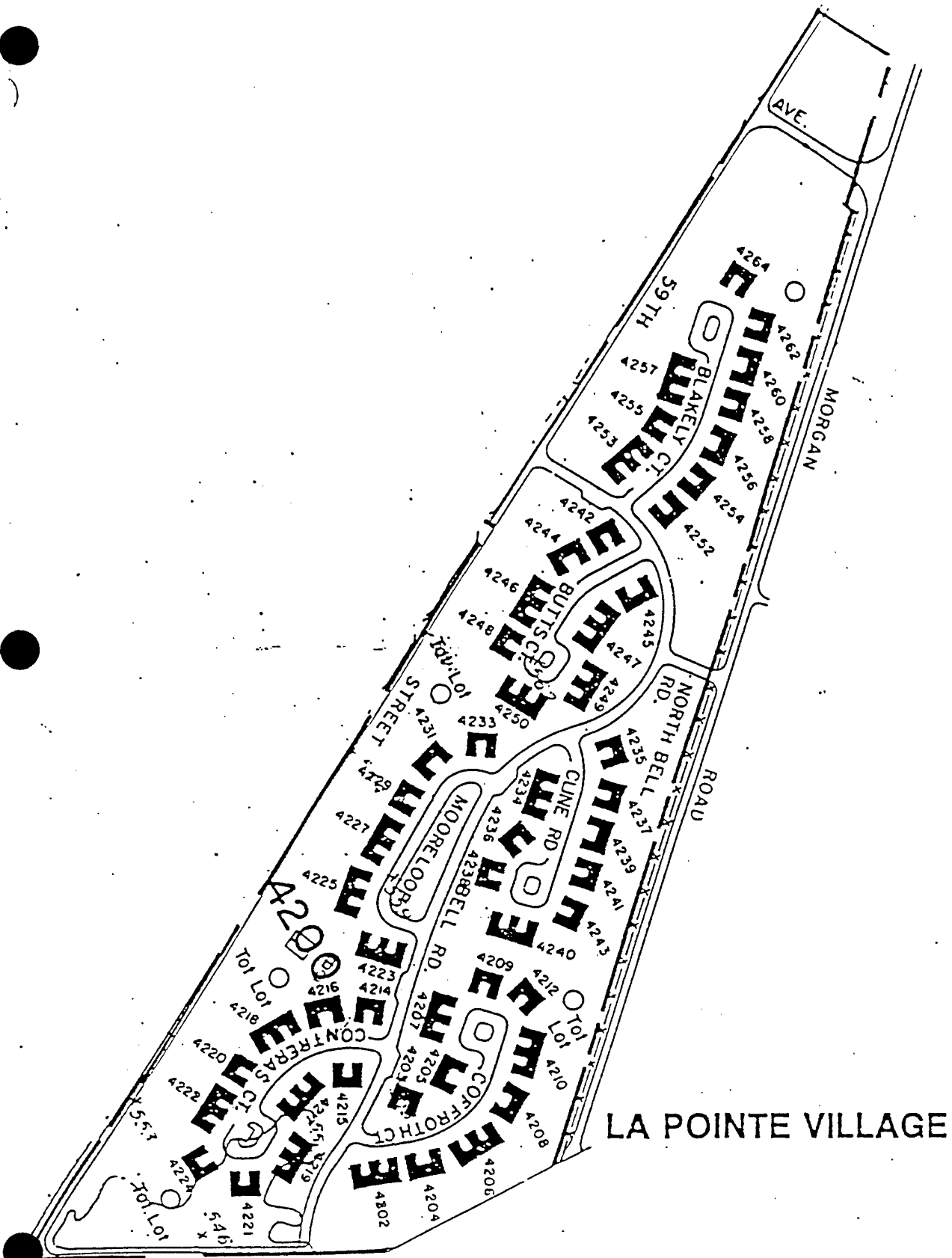
HAMMOND HEIGHTS



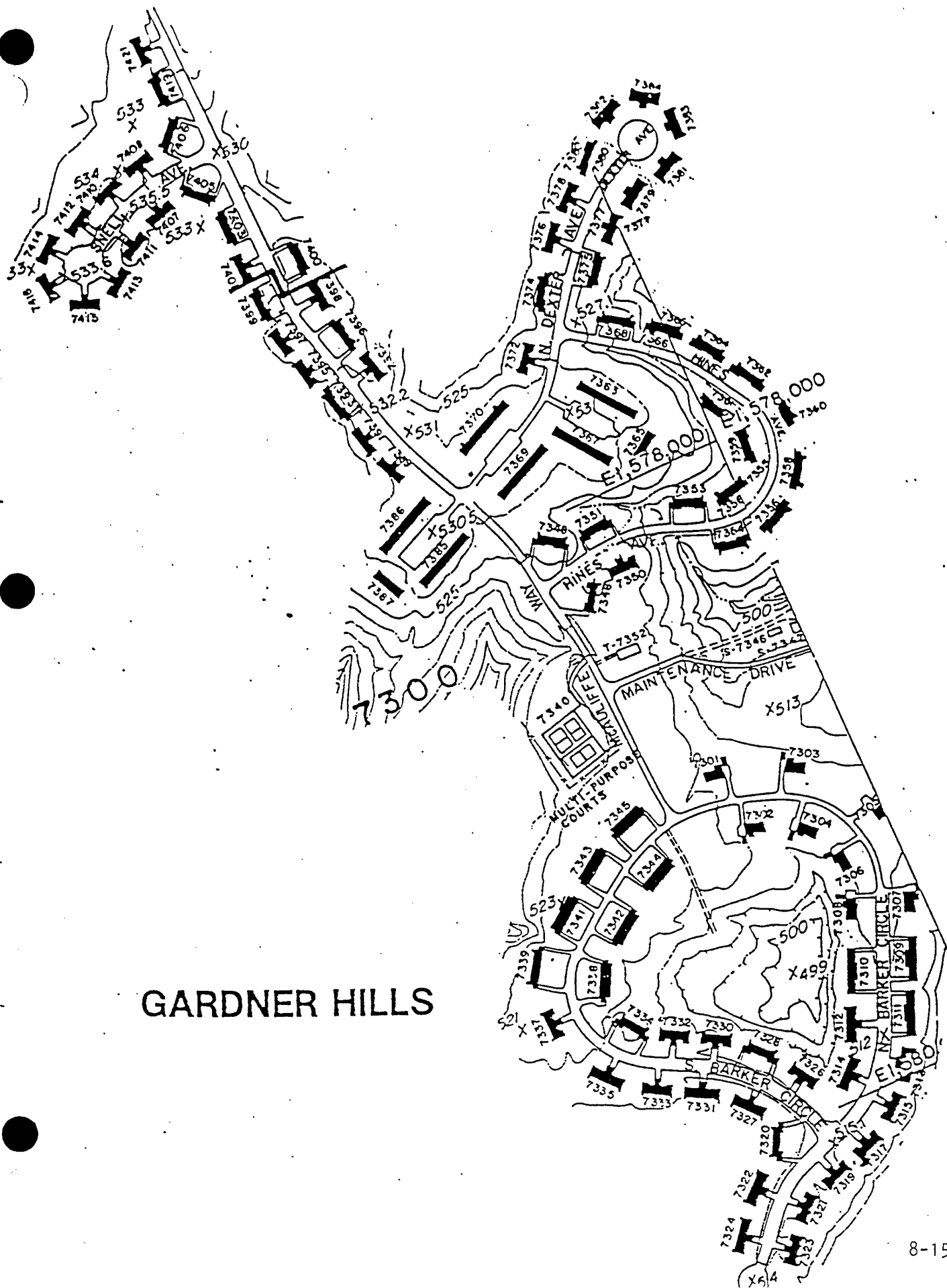
LEE VILLAGE



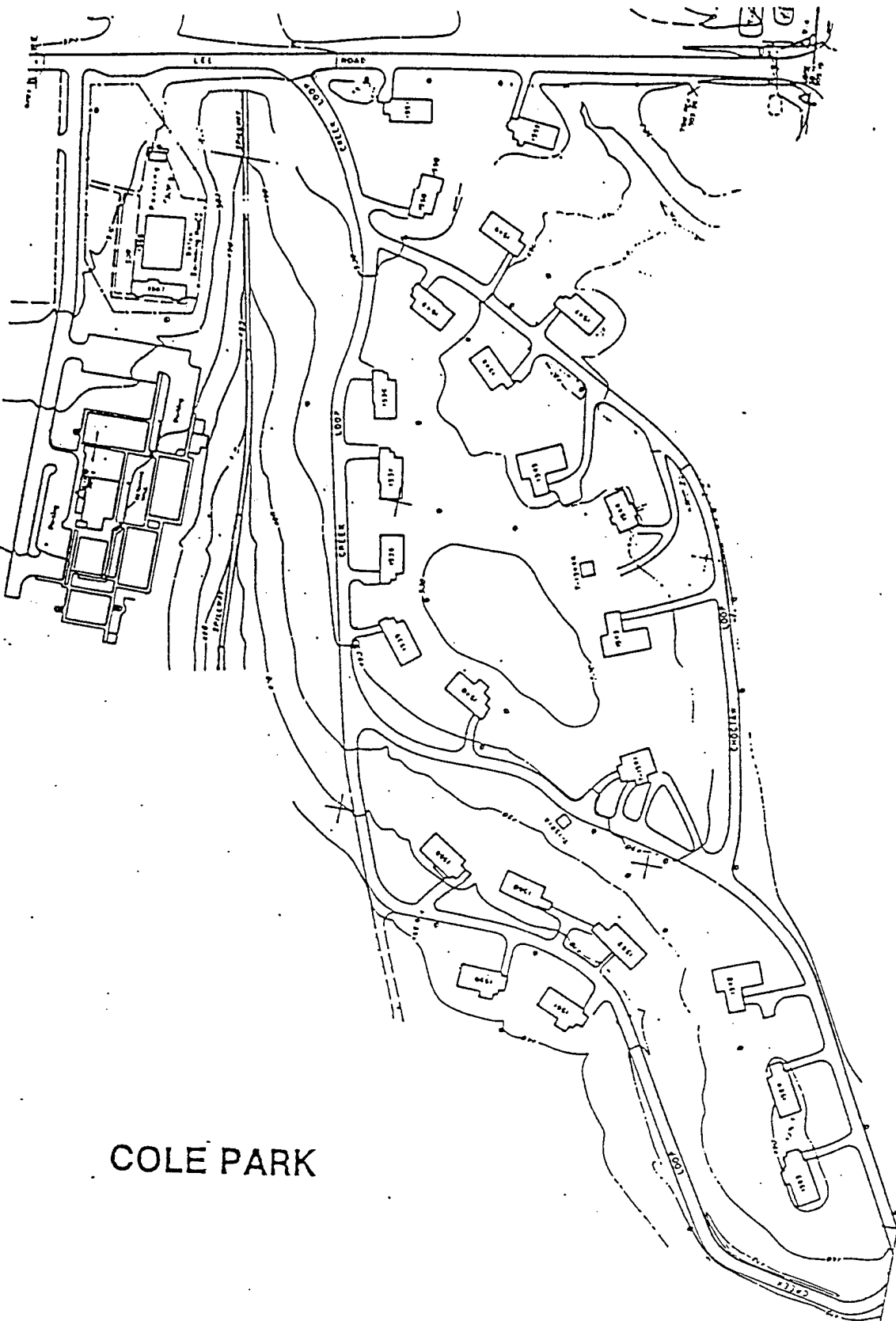
PIERCE VILLAGE



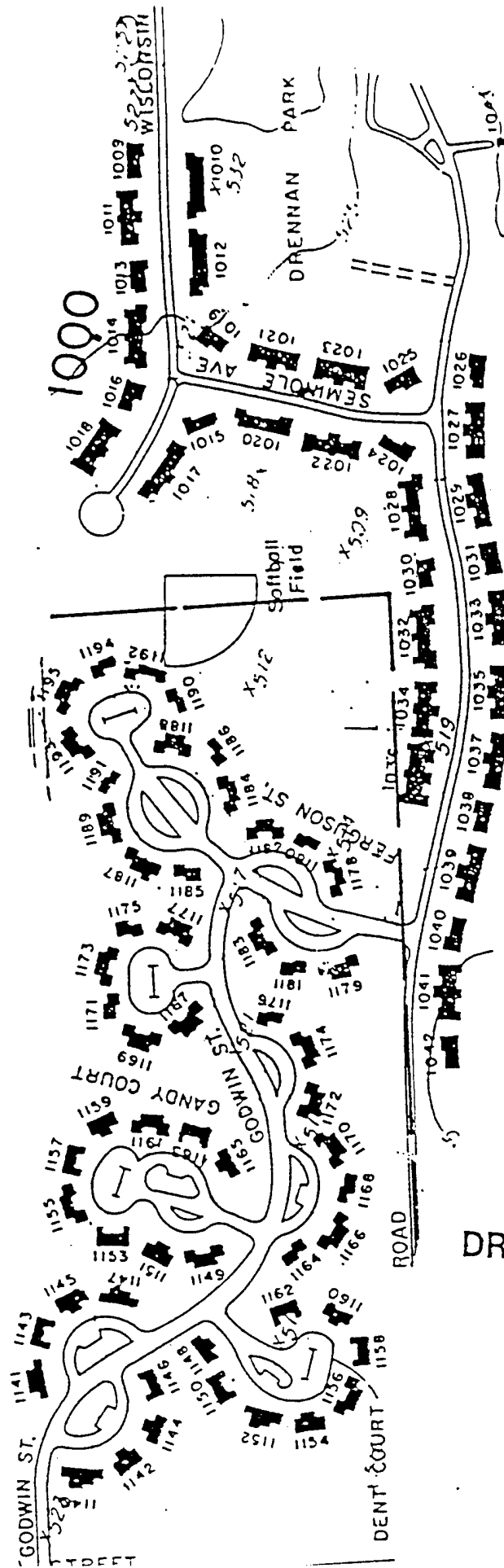
LA POINTE VILLAGE



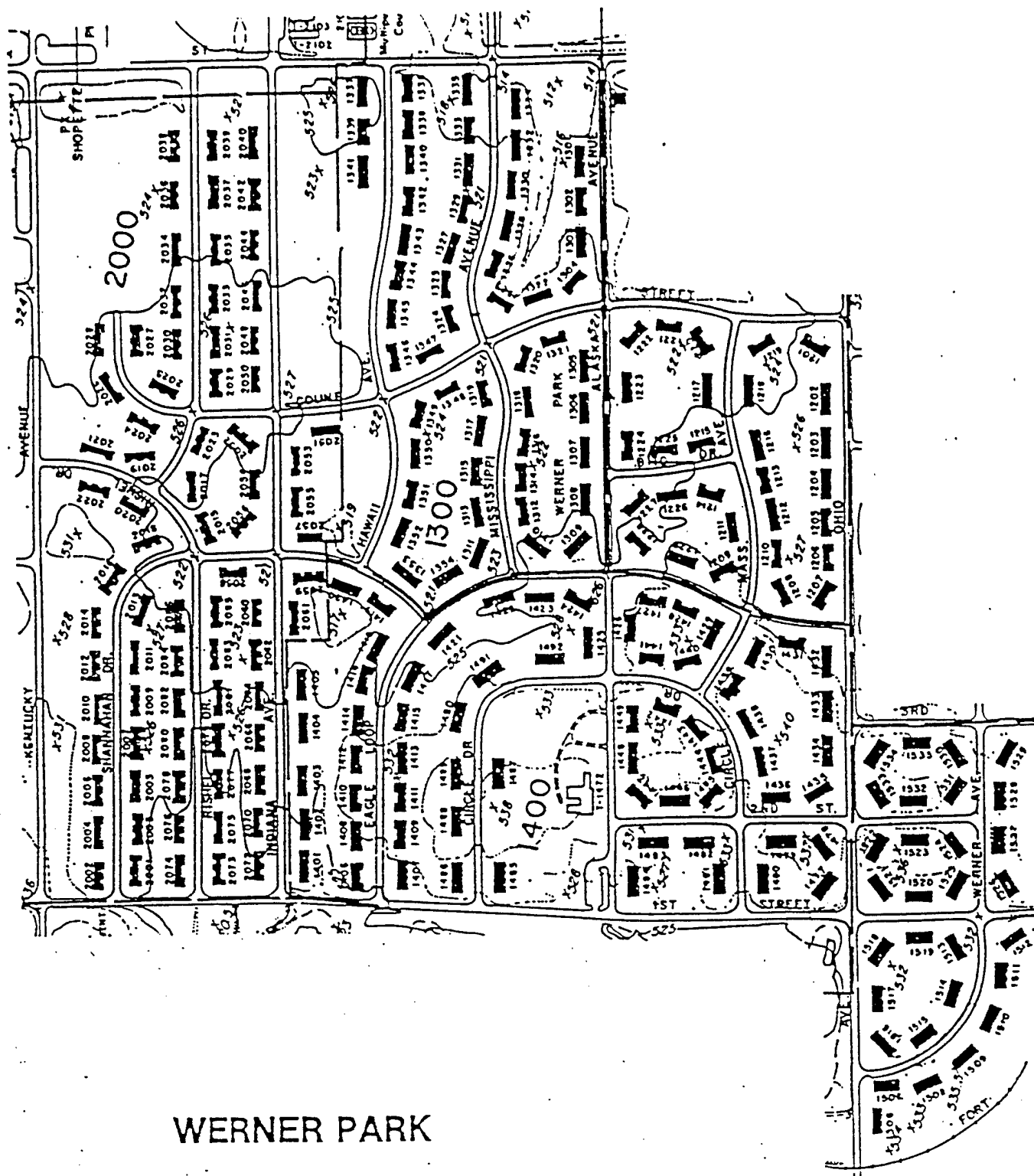
GARDNER HILLS



COLE PARK



DRENNAN PARK



WERNER PARK

FIGURE E-6.1. SCHEDULE for the Phase I, and Phase II Option ESOS, FY93 EEAP, FORT CAMPBELL, KY, if awarded simultaneously:

<u>Item</u>	<u>Calendar Days</u>		<u>Actual Date</u>
1. CBD ANNOUNCEMENT.....	0	..	16 Mar 93
2. CBD CLOSED.....	0	..	15 Apr 93
3. SOW APPROVED BY COE/DEH/MACOM.....	0	..	15 Apr 93
4. PRESELECTION/SELECTION BOARD.....	0	..	6/7May 93
5. RFP LETTER TO A/E.....	0	..	18 May 93
6. RFP LETTER RECEIVED BY A/E..... (COE, MACOM, DEH, and A/E coordinates date)	0	..	20 May 93
7. ENTRY INTERVIEW @ Fort Campbell (FC)..... (prior to Pre-negotiation SOW Mtg. DEH, COE, and A/E)	0	..	27 May 93
8. PRE-NEGOTIATION SCOPING MEETING @ FC..... (for RFP, neg'ns, scoping w/DEH,COE,MACOM,et.al.)	0	..	27 May 93
9.a A/E SUBMITS PROPOSAL/NEG'Ns BEGIN.....	0	..	10 Jun 93
b Negotiations begin/ends			14-18J 93
10. AWARDability CONTRACT-START/NTP..... (field analysis begins by A/E)	1	..	28-30J 93
11. INTERIM SUBMITTAL..... (all field work completed/ECOs analyzed)	60	..	01 Sep 93
12. REVIEW PERIOD OF THE INTERIM SUBMITTAL..... (COE gathers comments from IN-HOUSE/DEH/MACOM)	75	..	15 Sep 93
13.a.INTERIM COMMENTS TO A/E (COE to A/E).....	76	..	16 Sep 93
b.INTERIM CONFERENCE/ A/E PRESENTATION @ FC...	83	..	22 Sep 93
14. PREFINAL SUBMITTAL.....	120	..	01 Nov 93
15. REVIEW PERIOD.....	127	..	08 Nov 93
16. PREFINAL CONFERENCE @ FC..... (COE, MACOM, DEH, and A/E presentation)	130	..	11 Nov 93
17. EXIT INTERVIEW..... (COE, DEH, MP, and A/E)	130	..	11 Nov 93
18. FINAL SUBMITTAL..... (A/E sends directly to listed-the ESOS)	175	..	06 Dec 93
19. DEH SUBMITS DD form 1391's..... (A/E may be required to have input)	211	..	03 Jan 94

NOTE: Option, Phase II, if awarded separately, will follow 9. through 18. as listed above for the schedule.

FIGURE B-7.1. Distribution of Submittals: The A/E shall make direct submittal and responses to comments as indicated by the following schedule:

<u>Organization</u>	<u>Correspondence</u>			
		<u>Executive Summary</u>		
			<u>Reports</u>	
				<u>Fieldnotes</u>
COMMANDER, US Army Engineer District, Louisville ATTN: CEORL-ED-M/Charles Lockman P.O. Box 59 Louisville, KY 40201-0059 (tel. 502-582-6041, or fax# 6763, or 5281)	1	1	2	1*
HQ 101 Abn Div (AASLT) & Ft. Campbell ATTN: AFZB-DE-R-M/Arlin E. Wright 16th & Ohio St., Bldg. T-865 (DEH) Fort Campbell, KY 42223-1291 (tel. 502-798-8895, or fax# 9596)	1	1	2	1*
Headquarters FORSCOM (MACOM) ATTN: FCEN-RDF/Naresh Kapur Fort McPherson, GA 30330-6000 (tel. 404-669-6731, or fax# 6122 or 7751)	1	1	1	1*
COMMANDER, US Army Engineer District, Mobile ATTN: CESAM-EN-CC/Tony Battaglia (EEAP TCX) P.O. Box 2288 Mobile, AL 36628-0001 (tel. 205-690-2618, or fax# 2424)	1	1**0		0
COMMANDER, US Army Engineer Div., Ohio River ATTN: CEORD-DL-M/Joe Semrad P.O. Box 1159 Cincinnati, OH 45201-1159 (tel. 513-684-3975)	0	1**0		0
COMMANDER, US Army Engineer Div., S. Atlantic ATTN: CESAD-EN-TE/John Baggette 77 Forsyth Street, S.W. Atlanta, GA 30335-6801	0	1**0		0
COMMANDER, US Army Corps of Engineers ATTN: CEMP-ET/Dan Gentil (EEAP Mgr.) 20 Massachusetts Avenue Washington, D.C. 20314-1000 (tel. 202-272-0430)	0	1**0		0
COMMANDER, US Army Logistics Evaluation Agency ATTN: LOEA-PL/Mr. Keath New Cumberland Army Depot New Cumberland, Pa. 17070-5006	0	1**0		0

* Field Notes submitted in final at Interim submittal.
** Submit copies of the final Executive Summary Only

October 5, 1993

COMMANDER, US Army Engineer District, Louisville
ATTN: CEORL-ED-M/Charles Lockman
P.O. Box 59
Louisville, KY 40201-0059

Dear Mr. Lockman:

Attached are the minutes from the Interim Review Meeting at Fort Campbell on September 23, 1993. Also attached are the responses to the Interim Review Comments from yourself and Naresh Kapur.

If you have any questions or comments, please feel free to contact me at (615) 521-6536.

Sincerely,

Systems Corp

Keith A. Derrington

Keith A. Derrington

Enclosures: Interim Review Minutes, Interim Review Comment
Responses

cc: Arlin E. Wright, AFZB-DE-R-M
Naresh Kapur, FCEN-RDF
Tony Battaglia, CESAM-EN-CC

**ENERGY SAVINGS OPPORTUNITY SURVEY
FORT CAMPBELL, KY
PHASE I**

INTERIM REVIEW MEETING SEPTEMBER 23, 1993

ATTENDEES:

Chuck Lockman	U.S. Army COE, Louisville District
Naresh Kapur	FORSCOM Representative
Arlin E. Wright	DEH - Fort Campbell
Len May	DEH - Fort Campbell
Larry Martin	DEH / O&M - Fort Campbell
Judi Hudson	DEH / O&M - Fort Campbell
Jack Rake	DECA - Fort Campbell
Keith Derrington	Project Manager - Systems Corp
Cheri Martin	Project Engineer - Systems Corp

The Interim Review meeting began at 7:30 a.m. with Chuck Lockman, Naresh Kapur, Arlin Wright, Keith Derrington, and Cheri Martin. These attendees surveyed typical buildings which represented each ECO evaluated including two buildings for lighting, one building for instantaneous water heaters, one chiller plant, and a drive through of family housing to observe street lights and heat pumps.

After the brief survey, the Interim Review presentation was begun at 9:30 with all of the listed attendees. Systems Corp representative Cheri Martin presented an overview of the progress to date for Phase I. Both Systems Corp representatives discussed how each ECO was evaluated and the results achieved.

Project groupings were discussed for the Prefinal submittal. Lighting, ECO-5, would remain as one project with NAF facilities removed from the grouping. The ground water coupled heat pumps would remain as one project. A programming document would not be prepared for ECO-3, Heat Recovery at the Commissary, due to the project cost and the funding type. The chillers, ECO-4, would remain as one project.

It was determined with Arlin Wright and Chuck Lockman that certain barracks were scheduled for demolition which were evaluated under ECO-4. These building numbers were found and will be removed from the project grouping.

The procedures for evaluating each ECO were discussed in further detail with Naresh Kapur after the review presentation. Mr. Kapur's Interim Review comments were discussed and resolved.

Chuck Lockman's Interim Review comments were received and discussed. Responses to Mr. Lockman's and Mr. Kapur's comments are attached.

Phase II ECOs were also discussed. The results of ECO-4 indicate that the existing absorption chillers at the barracks will be replaced. If this occurs ECO-7, Waste Heat Recovery, will not be economically feasible. The use of generators at the Water Treatment Plant and Boiling Springs Pump Station will be evaluated for use for peak shaving as a replacement ECO. This will be substituted for ECO-7, Waste Heat Recovery, for Phase II. Due to the results of ECO-1, a substitution ECO was discussed. One additional ECO was added, Commissary Lighting. The lighting at the Commissary will be surveyed and evaluated for replacement. This will become ECO-11.

The meeting was concluded at approximately 11:30 a.m.

**ENERGY SAVINGS OPPORTUNITY SURVEY
FORT CAMPBELL, KY
PHASE I**

INTERIM REVIEW COMMENTS AND RESPONSES

REVIEWER: CHARLES LOCKMAN, LOUISVILLE DISTRICT CORP OF ENGINEERS

Comment No. 1 (Vol 1 Sec 2):

Paragraph number 2.1.2 Exterior Lighting - SOW was for 5 family housing areas but report, while ESOS says 4. Is this true on site numbers? Gardner?

Response:

The statement of work was for 5 family housing areas. Only 4 areas were evaluated. The fifth area, Gardner Village, contained only 100W high pressure sodium fixtures so no savings opportunity was present.

Comment No. 2 (General):

Table of Contents at the beginning of each Volume would assist in looking at each individual notebook volume.

Response:

All future reports will contain an overall Table of Contents in Volume 1 along with a Table of Contents for each volume detailing the information contained in that volume (including Volume 1).

Comment No. 3 (General):

The COE Castle Symbol on the front of each volume is to be placed there.

Response:

No response required.

Comment No. 4 (General):

Table of Contents - Can the volumes be identified on it so one can readily go to that volume of review.

Response:

Please refer to response to Comment Number 2.

Comment No. 5 (General):

My end label on the volume was labeled as Volume 1, should be 2.

Response:

This is an error on our part and will not reoccur.

Comment No. 6 (Vol 5 Sec 10):

10.1 The COE commends the firm in prompt quickness in getting on the field work even before award of the contract which assisted in doing Phase I according to schedule as scoped and even earlier submittal is noted by the COE. The number of teams put together for each ECO is commendable. We note that the total contact locations (3) were all considered team and by discipline along with a completed schedule of intent before funding was finally given.

Response:

No response required.

REVIEWER: NARESH KAPUR, HQ FORSCOM

Comment No. 1 (General):

Systems Corp's 7 volume Interim Report is well documented and an honest effort to do a very good job. It is indeed praise worthy.

Response:

No response required.

Comment No. 2 (General):

We suggest a reduction in volume of the next submittal as far as possible, by:

A) Combining information from several pages on one or two pages, eg. pgs 9-598 to 9-603 could be just one page.

B) Printing on both sides of pages if practical. It may reduce the number of pages in the report by half approximately.

Response:

The referenced pages numbers are from the cost estimates as required in the scope of work. To combine on one page would be a very labor intensive process and is logistically not practical. Printing on both sides of paper is also logistically more difficult and very time consuming.

Comment No. 3 (General):

Beef up description of all ECOs. It should state the current situation, future situation, and method of achieving change. Mention sources of energy and non-energy savings. Refer to sketches or catalog cut type information as appropriate. Some ECOs like lighting may consist of Sub-ECOs. Variations may be explained by footnotes in LCCA.

Response:

This will be noted for future submittals.

Comment No. 4 (General):

For each LCCA, either use a more descriptive title or add a footnote explaining the intent of that particular ECO.

Response:

This will be noted for future submittals.

Comment No. 5 (General):

In each LCCA summary, cross reference where each important figure can be located unless it is on the immediately following pages. Calculations for 3A & B need to be identified also.

Response:

The LCCA summary is an output of the LCCID computer model and will not allow for the above suggested annotations. Calculations for ECO 3 (3A & B are not recognized) are included in Section 7 and are organized and referenced identically to the other ECOs.

Comment No. 6 (General):

For each ECO, list the following items:

Building No (SF)
EST Cost
SIR
PB
Remarks.

In the summary, total (overall) building SF, est cost, SIR, and SPB. This information can be provided up front.

Response:

No response required.

Comment No. 7 (General):

Chiller replacement ECO represents large investment and looks extremely attractive. As such consider explaining this ECO for each building while preparing listing IAW 6. Above, mention age of existing equipment for priority for replacement in remarks.

Response:

No response required.

Comment No. 8 (Vol 4 Sec 9):

We like to know which of LCCA represent delamp? Which ones represent reducing levels of FC?

Response:

Please refer to spreadsheet calculations for each ECO. These pages detail how each ECO will be implemented. These are located in report Sections 5-9.

Comment No. 9 (Vol 4 Sec 9):

Why is LED being used for exit sign retrofits? Are not more economical alternatives available?

Response:

The LED sign has the lowest life cycle cost as compared to compact fluorescent signs. This is due to no lamp replacements or maintenance required during the 15 year life of the fixture.

Comment No. 10 (General):

All projects/ECOs for AFH, PX, Commissary, and NAF buildings should be separated and identified accordingly. All applicable ECOs under each of the above funding sources should have separate listings of ECOS.

Response:

The referenced areas above will be separated for the Prefinal submittal.

Comment No. 11 (Vol 5 Sec 10):

Recommended projects and organization. We need to discuss. This may involve fine tuning between now and final submittal. We will work together.

Response:

No response required.

Comment No. 12 (Vol 5 Sec 11):

Is this section needed? If not, let us summarize the contents on one or two pages.

Response:

This section is required by the Scope of Work.

Comment No. 13 (Vol 6 Sec 14):

In the field notes, some areas are identified as overlit IAW applicable FC standards. Please make footnotes how the particular situation translates into an ECO. If no ECO is practical, say so. If an ECO is generated, make a cross reference. For example bldgs 3308, 6708, 6390, and 5740.

Response:

For each building with an overlit area, a specific fixture replacement is recommended. Please refer to the calculations (spreadsheets) for each building in Section 9 to see the recommendations.

ENERGY SAVINGS OPPORTUNITY SURVEY

Fort Campbell, Kentucky

Phase I

FT. CAMPBELL FIELD SURVEY

- Conducted July 12 - July 20, 1993
- 99 Buildings Surveyed
- 6 Family Housing Areas Surveyed

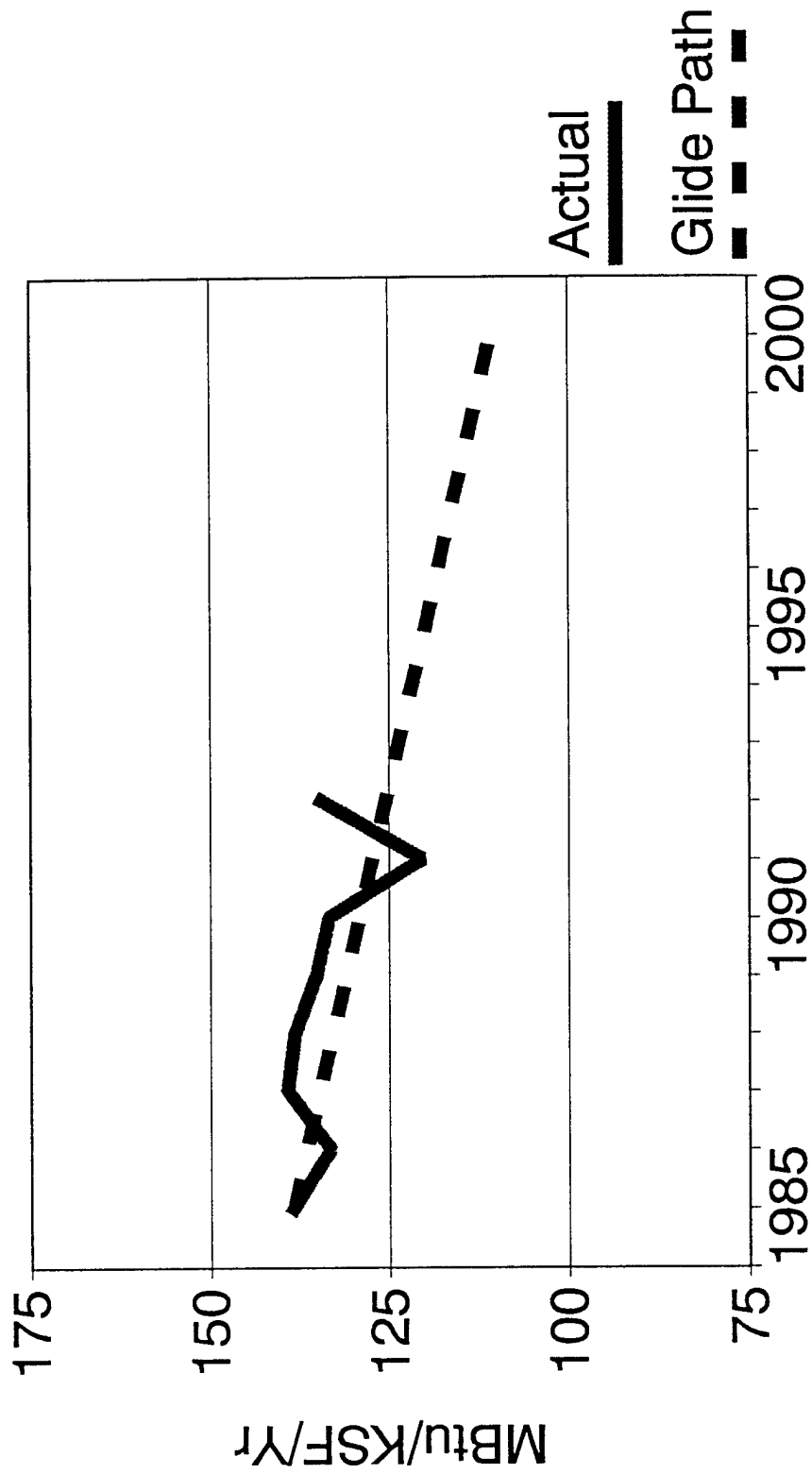
WORK ACCOMPLISHED TO DATE

1. Field Surveys Completed for 99 Buildings
2. Exterior Lighting Surveys for 5 FH Areas
3. Baseline Energy Models
4. Evaluation of 142 Energy Conservation Opportunities
5. Calculations and Reporting of Solid Energy Conservation Opportunities for Possible Implementation
6. Preparation and Completion of all Field Notes
7. Completion of Interim Reports

REMAINING PHASES

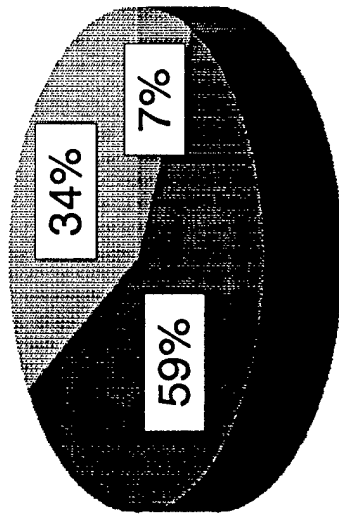
- Response to Interim Review Comments
- Preparation of Programming and Implementation Documents
- Prefinal Report
- Response to Prefinal Report Comments
- Final Report

Fort Campbell Energy Consumption

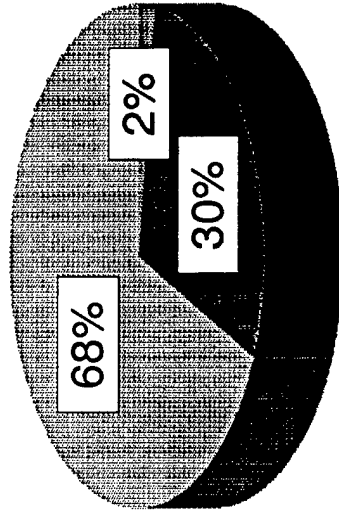


Fort Campbell Consumption vs. Cost

FY92



2,379,660 MBtu



\$16,599,000

Electricity Natural Gas Other

FT CAMPBELL ENERGY COSTS

Electric

Energy

\$6.19/MBtu

with Demand

\$13.48/MBtu

Natural Gas

\$4.00/MBtu

ENERGY CONSERVATION OPPORTUNITIES

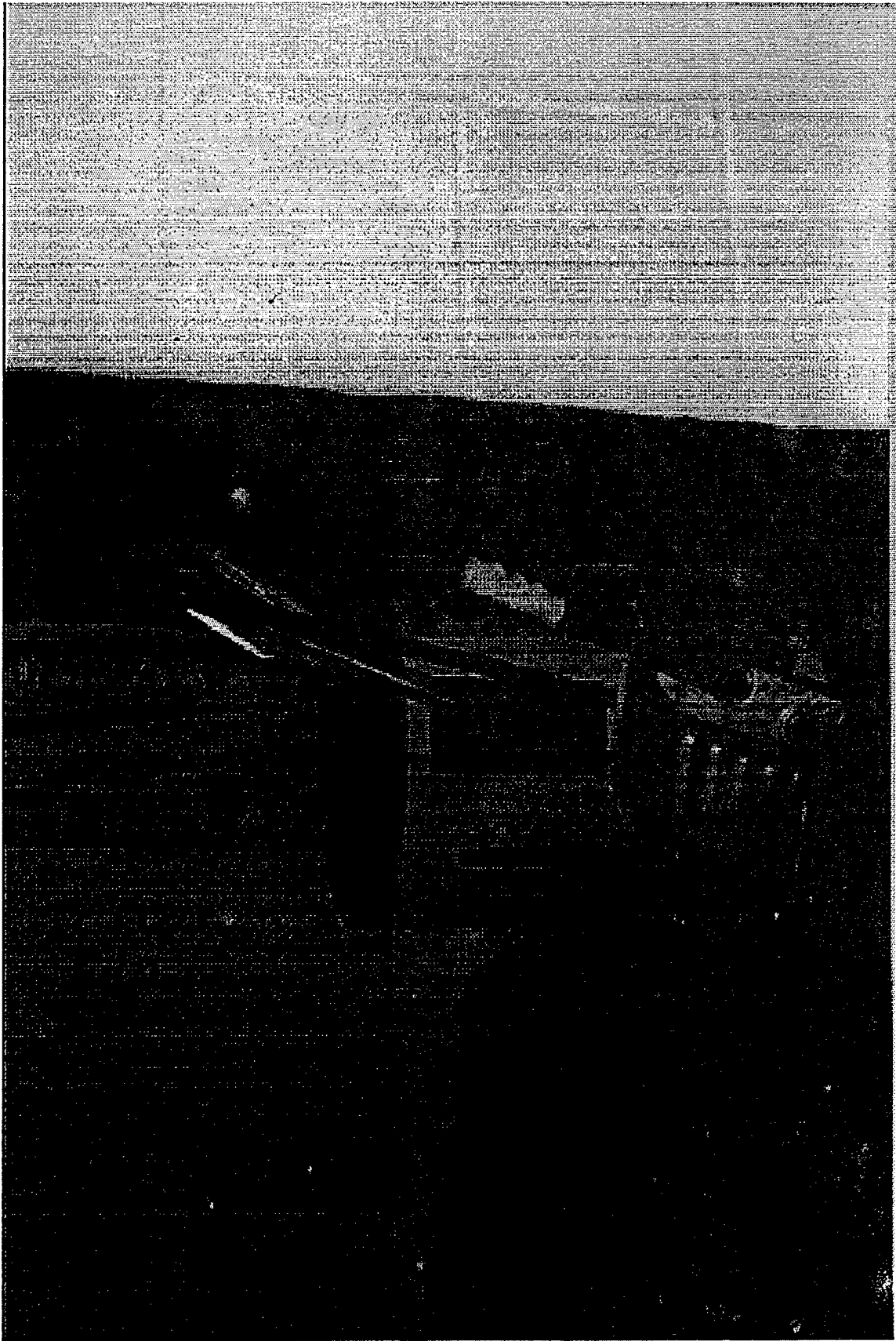
- ECO-1: Instantaneous Water Heaters
- ECO-2: Ground Water Coupled Heat Pumps
- ECO-3: Heat Reclaim at Commissary
- ECO-4: Absorbtion Chiller Replacement
- ECO-5: A. Indoor Lighting
B. Street Lighting

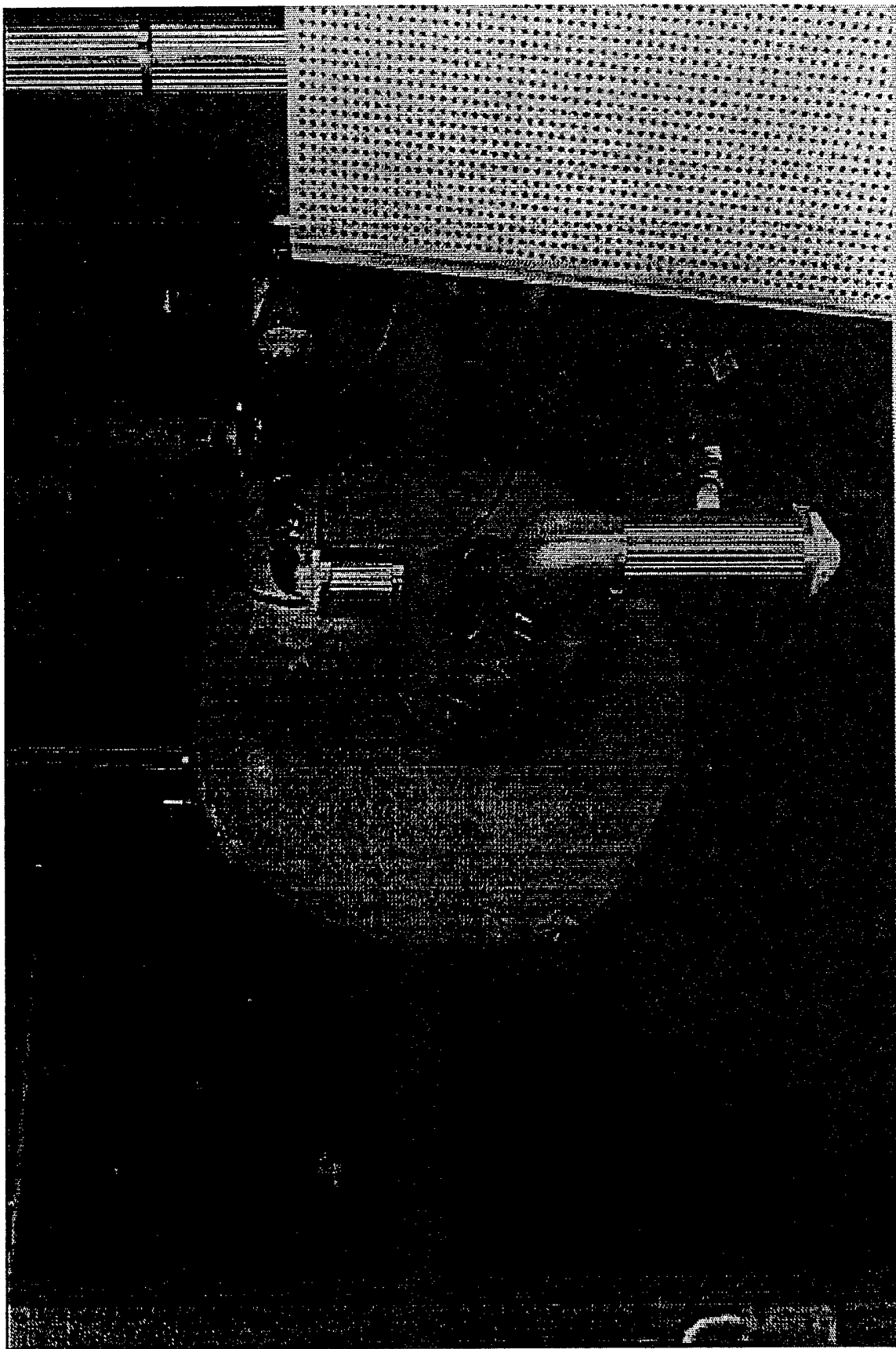
ECO-1: Instantaneous Water Heaters

- 77 Buildings Surveyed

ECO-1: Information Collected

1. Number of Demand Points and Types
2. Current Storage Temperature
3. Nameplate Data if Available
4. Water Heater Size
5. Number of Building Occupants and Hours

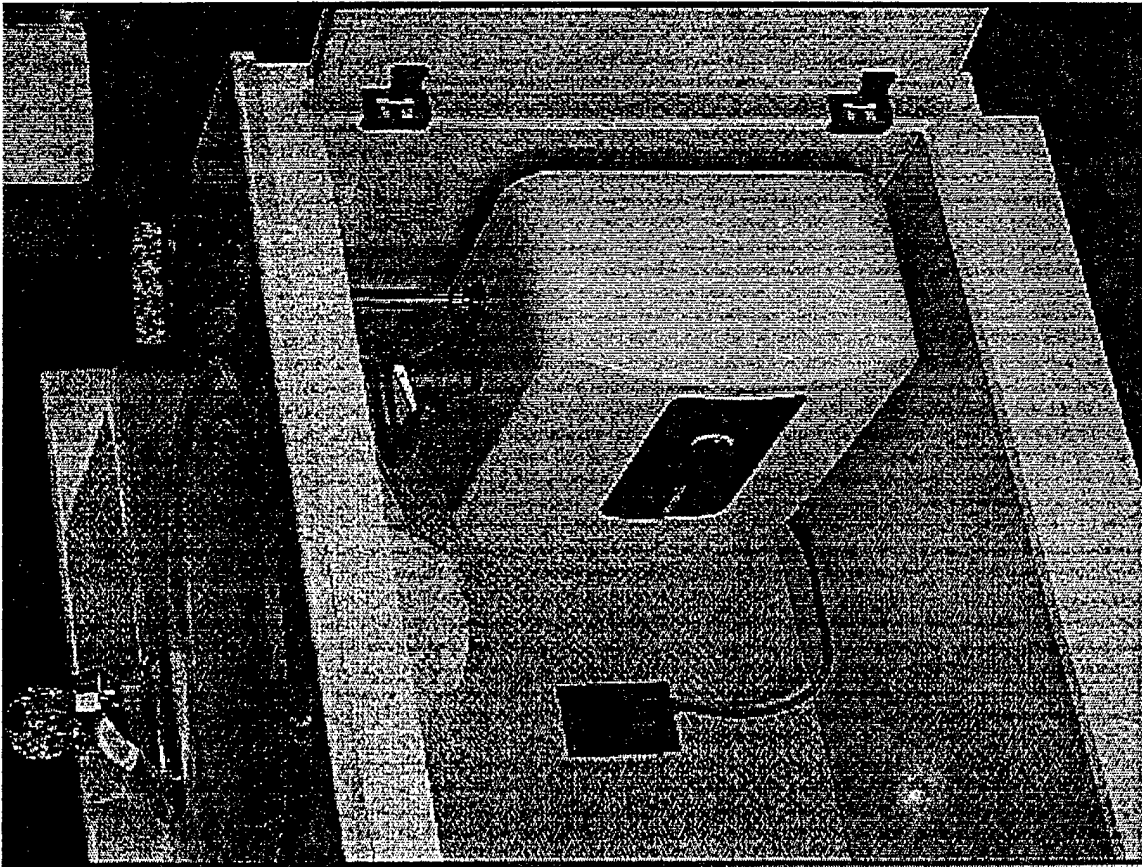




ECO-1: Replacement Options & Costs

<i>Options</i>	<i>Heater Costs</i>
Electric Instantaneous*	\$190
Steam Instantaneous	\$8,000
Small Storage Electric	\$140

*Note: Additional electrical costs will be incurred with this option.



ECO-1: Example Building

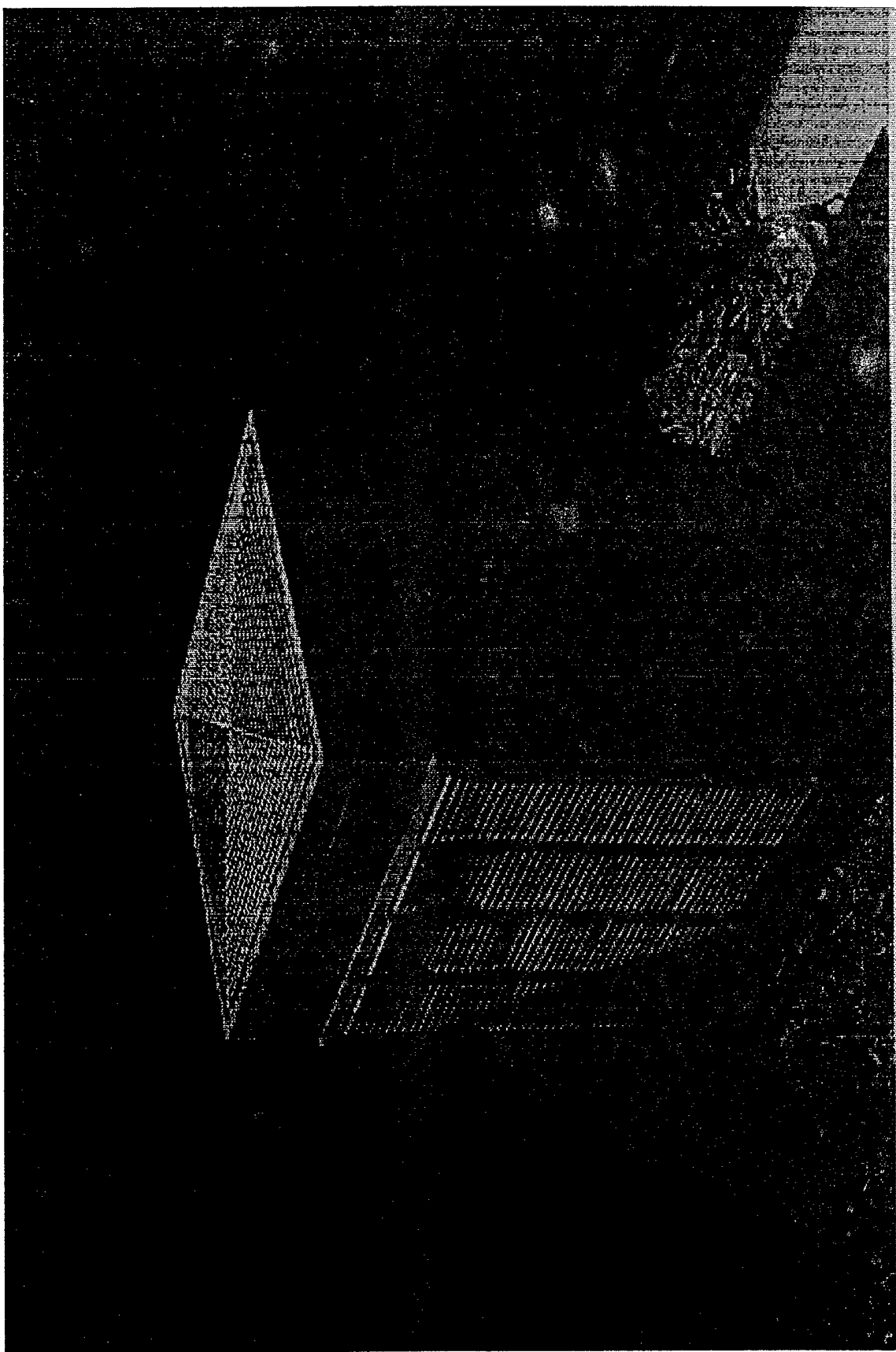
Building Number	6708
Energy Savings	3 MBtu/yr
Cost Savings	\$18/yr
Investment	\$467
SIR	0.55
SPB	26.42 yrs

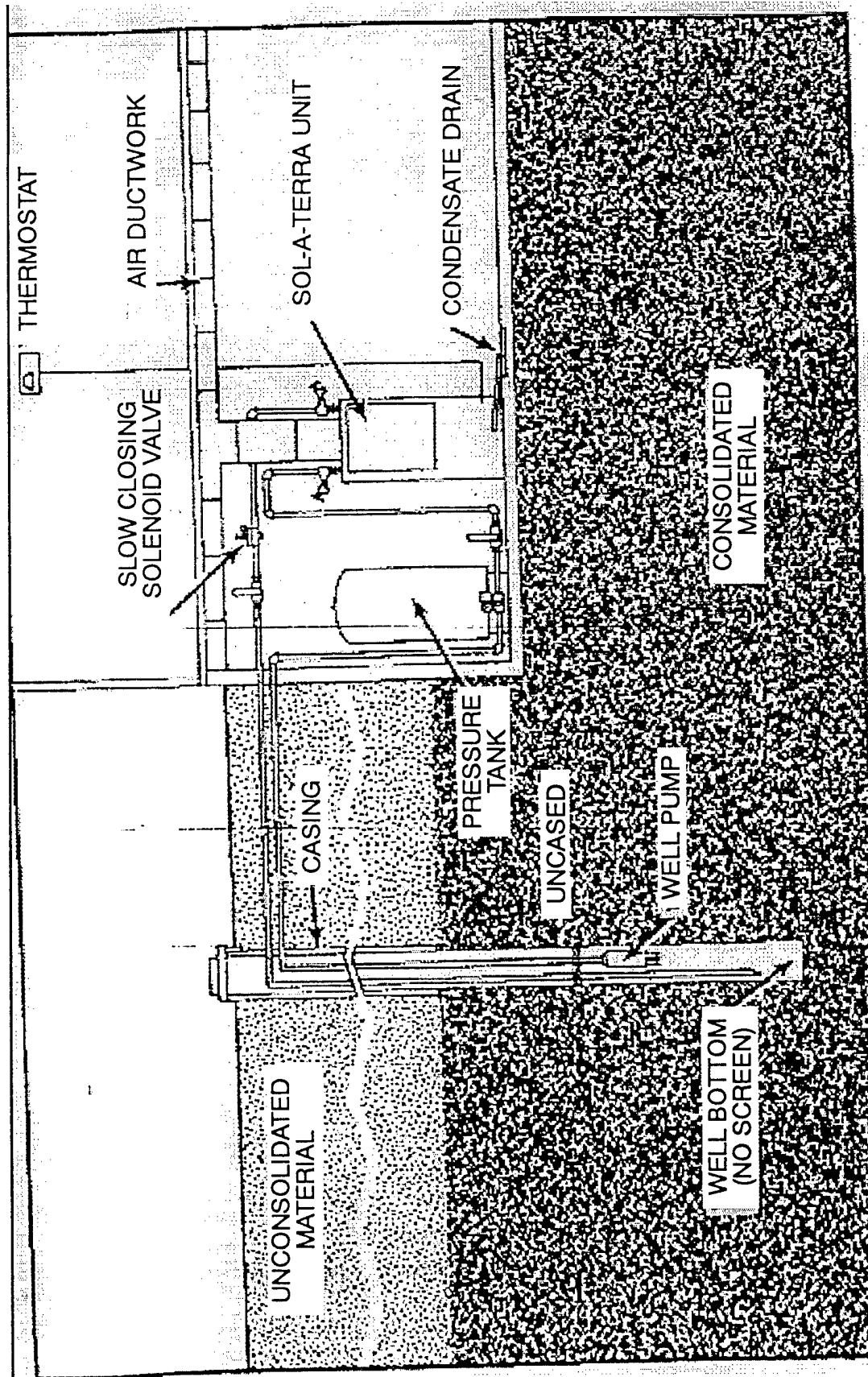
ECO-2: Ground Water Coupled Heat Pumps

- 3 Family Housing Areas Surveyed

ECO-2: Information Collected

1. Nameplate Data from Outside Unit
2. Nameplate Data from Inside Unit
3. Manufacturer's Data





ECO-2: Analysis Summary

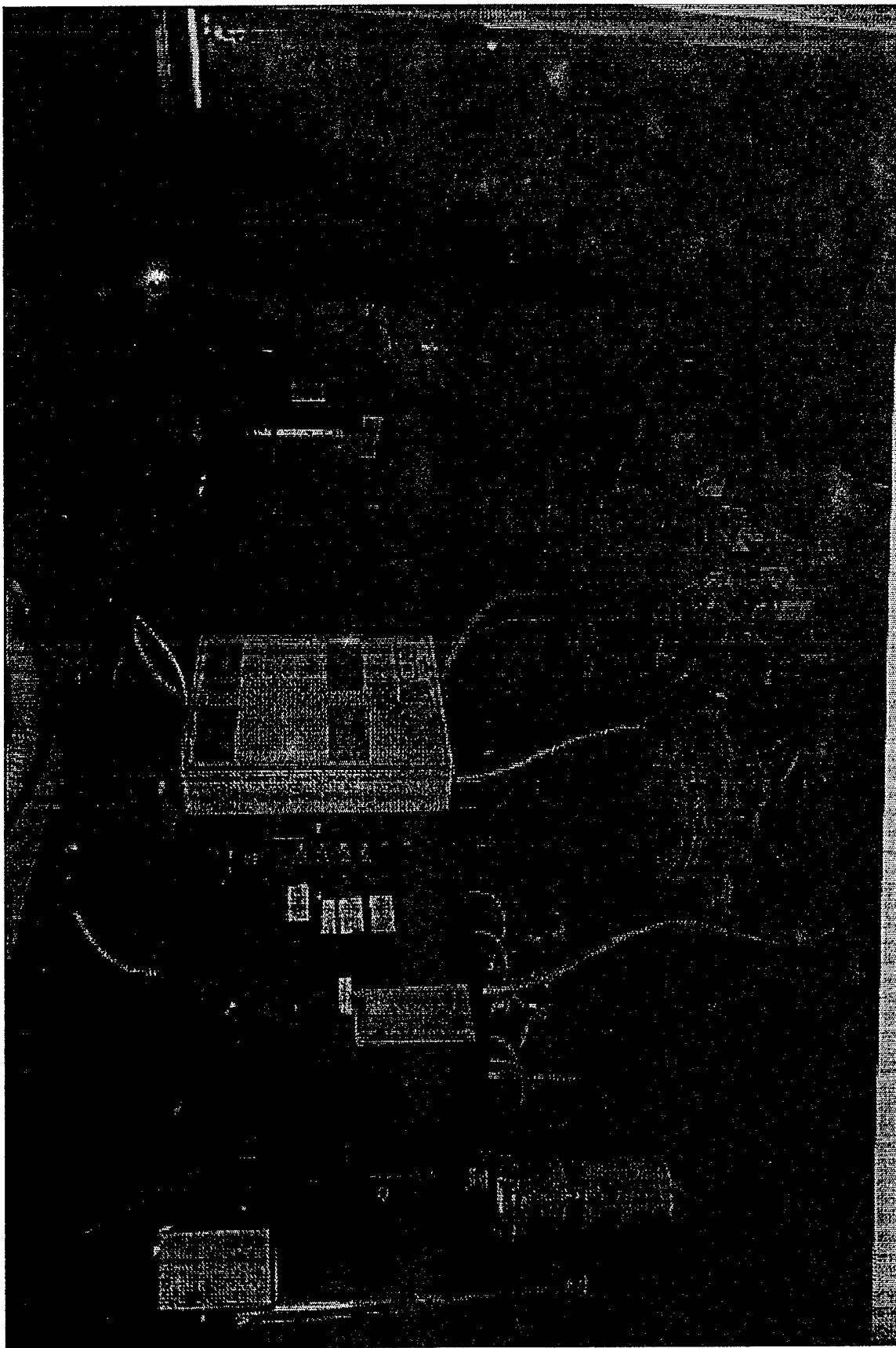
Energy Savings	39,544 MBtu/yr
Cost Savings	\$538,566/yr
Investment	\$4,837,740
SIR	1.80
SPB	7.98 yrs

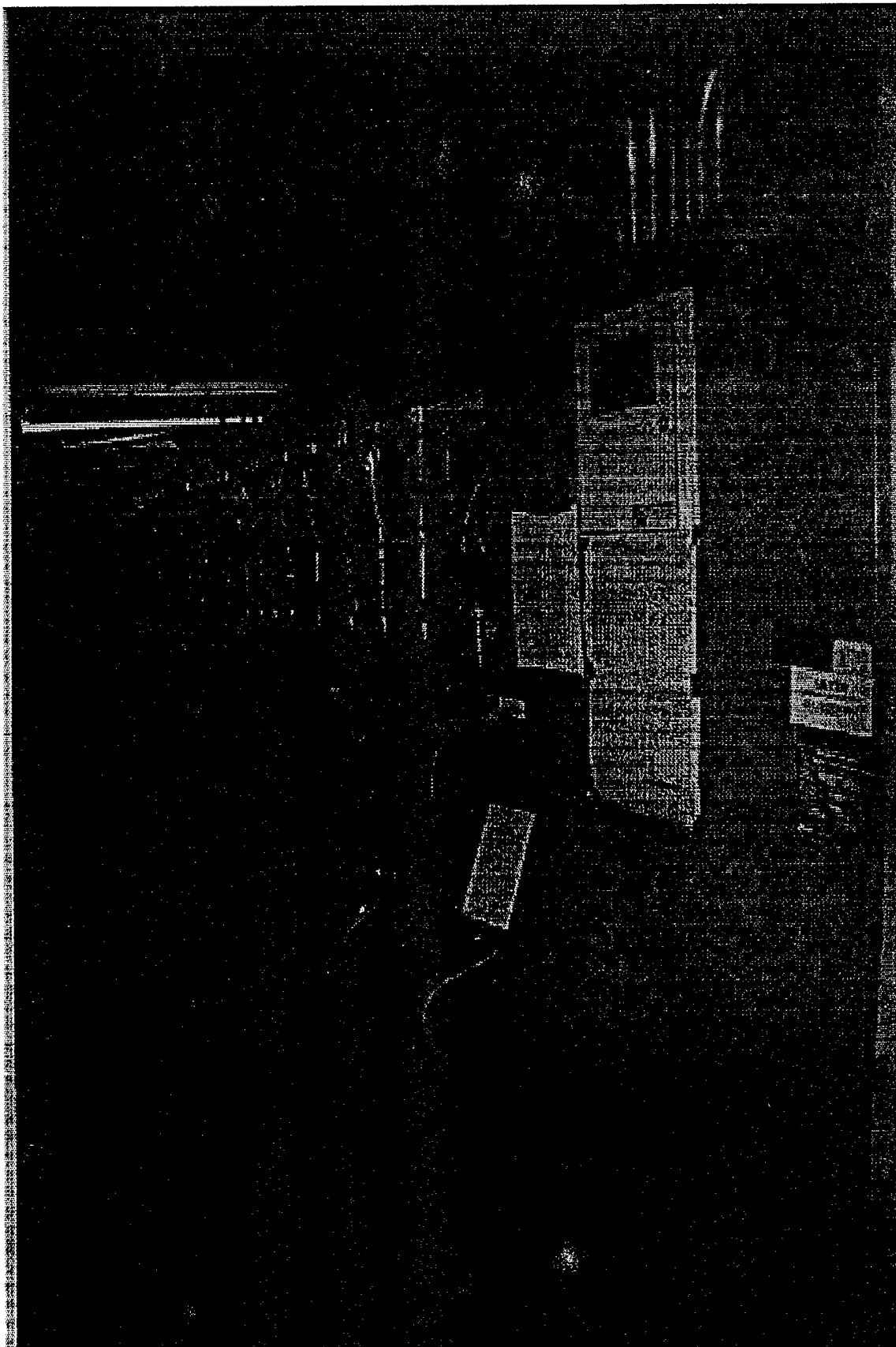
ECO-3: Reclaim from Hot Refrigerant Gas/Condenser Units

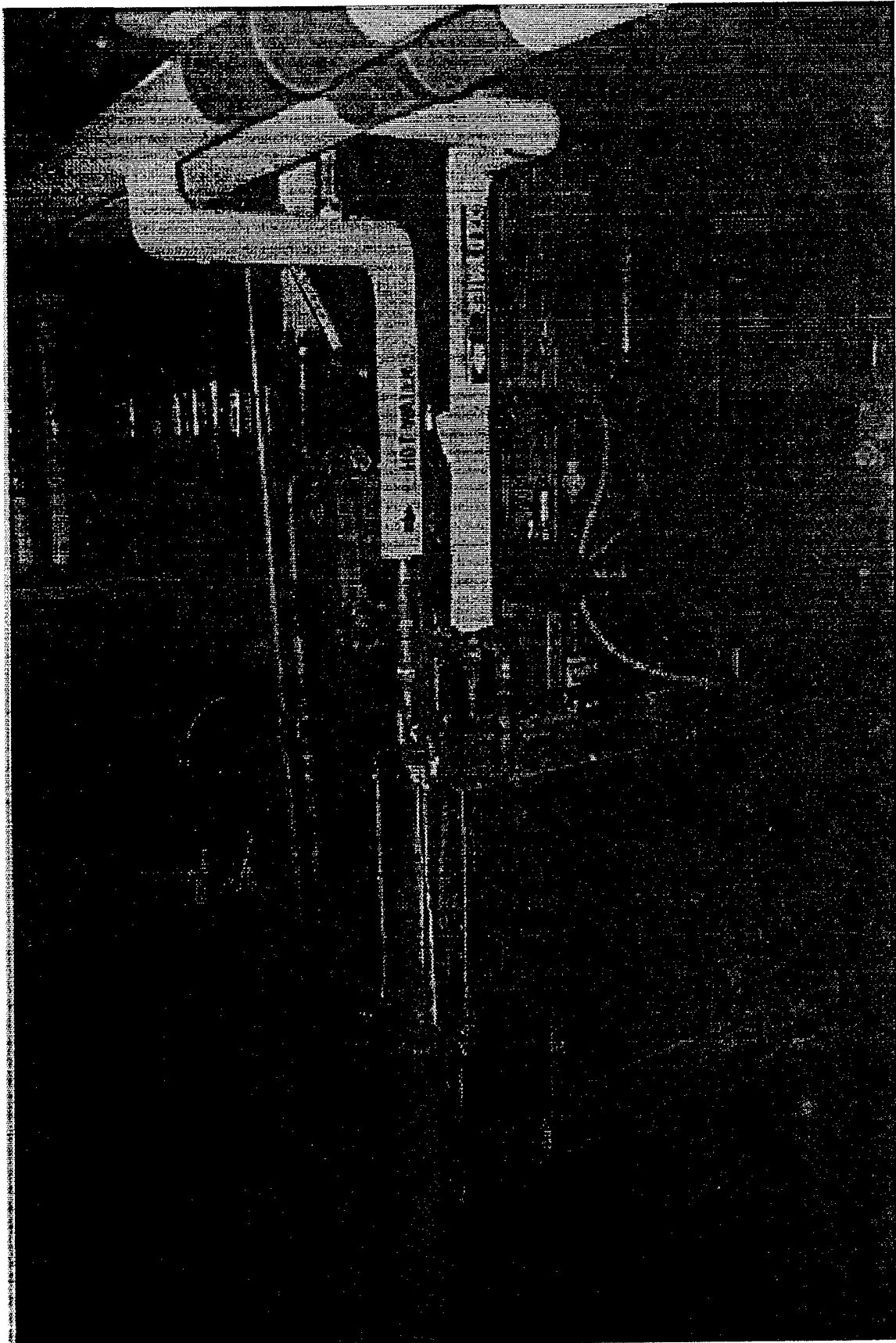
- Building 2702 - Commissary

ECO-3: Information Collected

1. Nameplate Data from Existing Equipment
2. Sketches of Equipment Layout
3. Nameplate and Temperature Measurements from Water Heaters







ECO-3: Analysis Summary

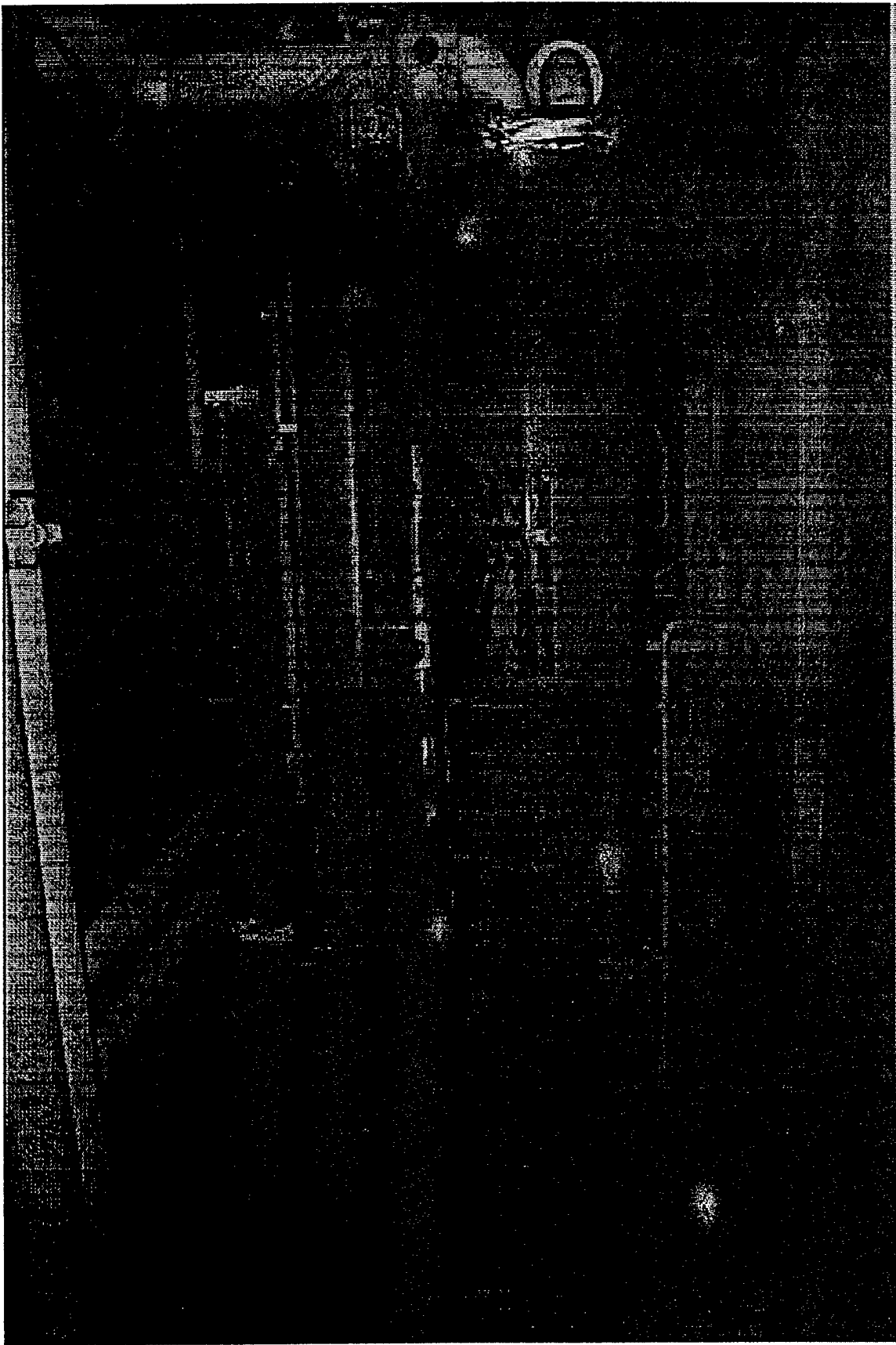
Energy Savings	298 MBtu/yr
Cost Savings	\$2,233/yr
Investment	\$19,240
SIR	1.86
SPB	8.62 yrs

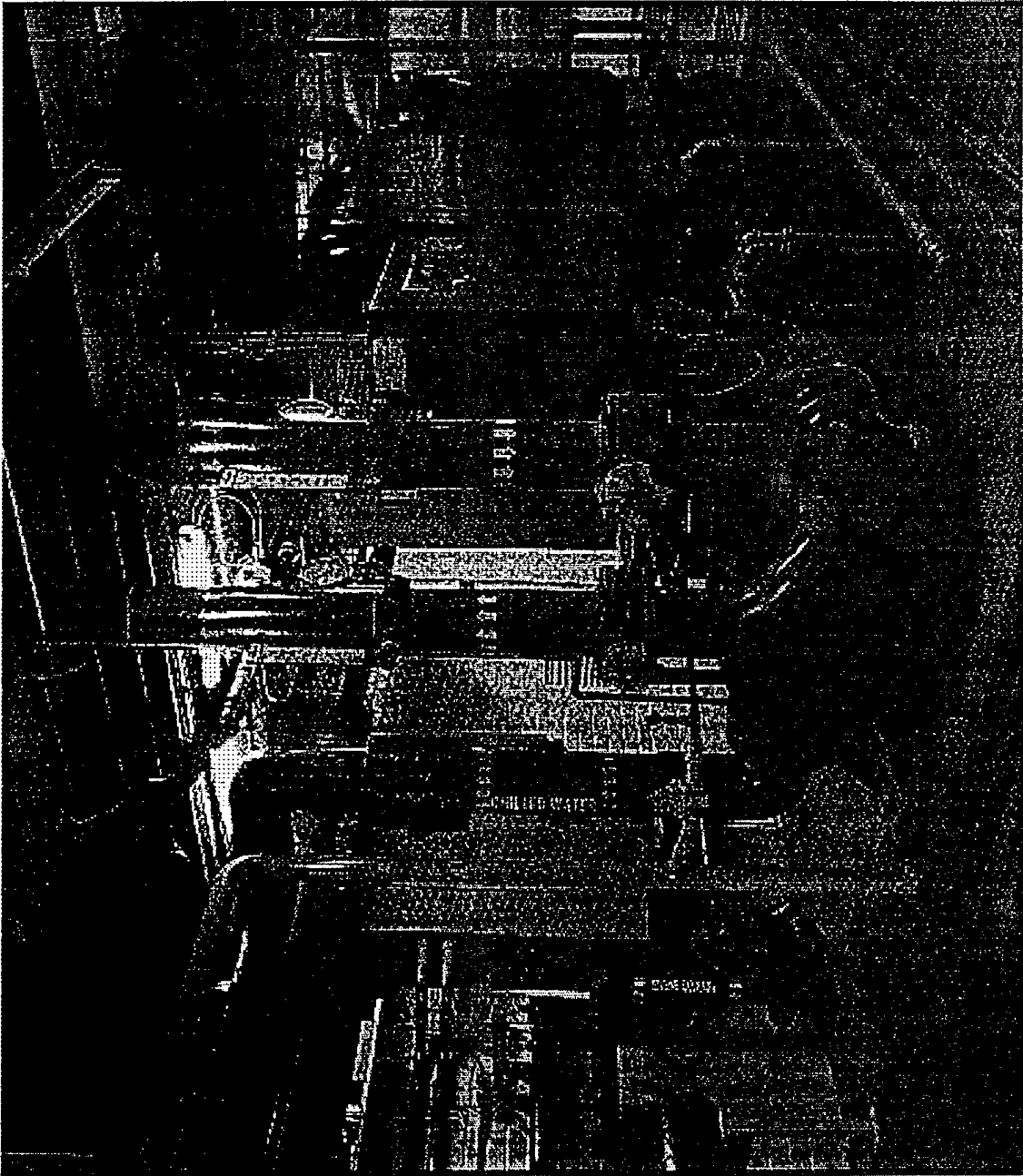
ECO-4: Absorption Chiller Replacement

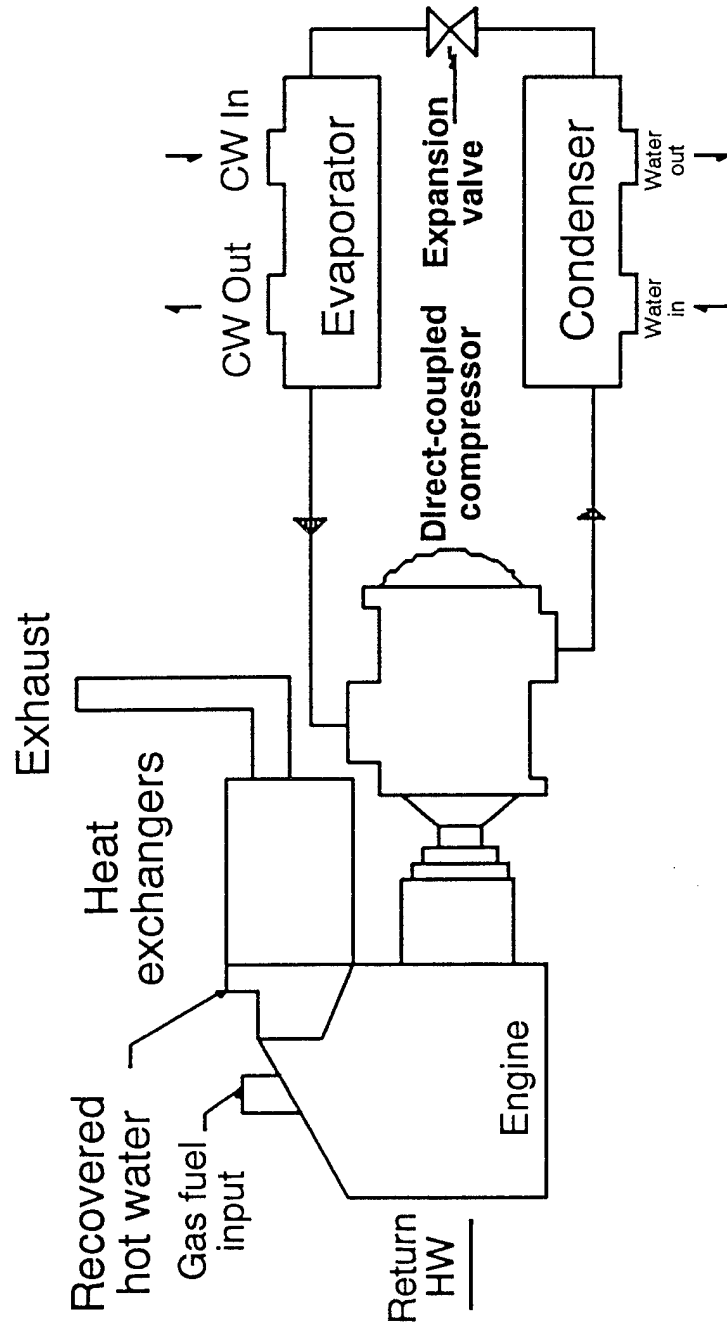
- 15 Building Surveyed

ECO-4: Information Collected

1. Manufacturer, Model, and Serial Numbers
2. Steam Pressure and Flow
3. Condenser Water Flow, Pressure Drop, and Temperature Rise
4. Chilled Water Pump Data
5. Condenser Water Pump Data







Gas Engine Driven Chiller

ECO-4: Analysis Summary

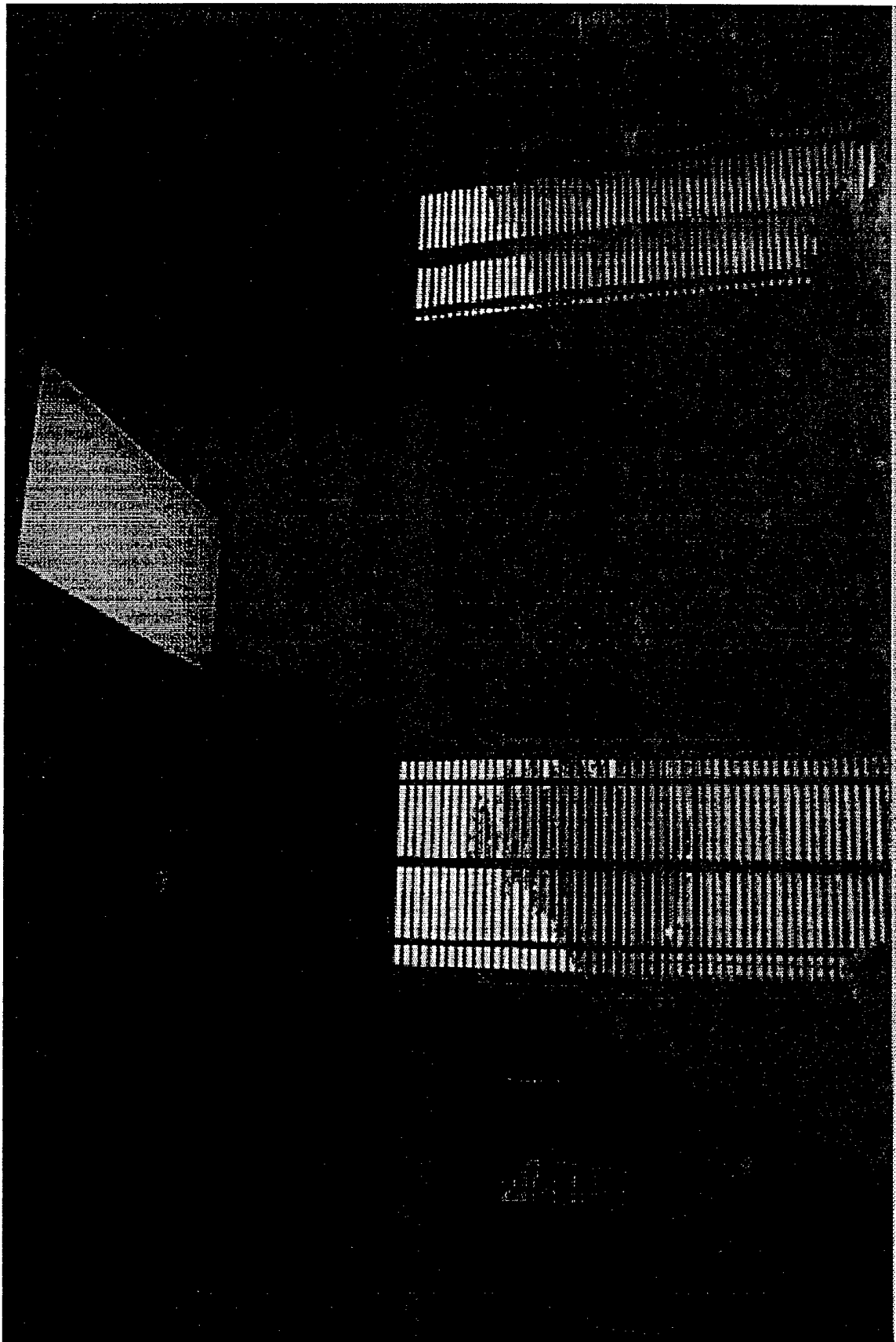
Energy Savings	406,432 MBtu/yr
Cost Savings	\$1,625,728/yr
Investment	\$4,023,230
SIR	8.90
SPB	2.26 yrs

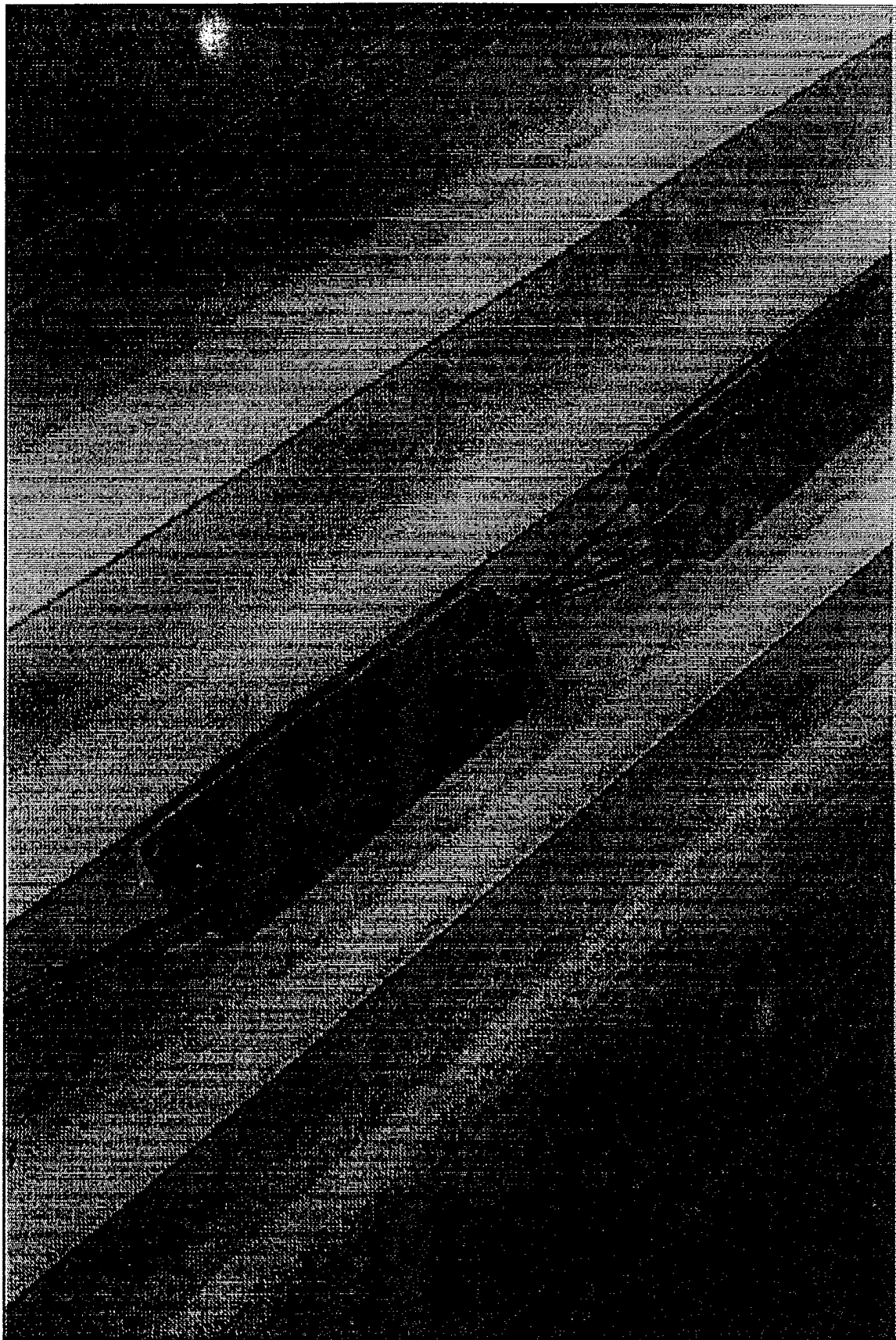
ECO-5: Indoor/Outdoor Lighting

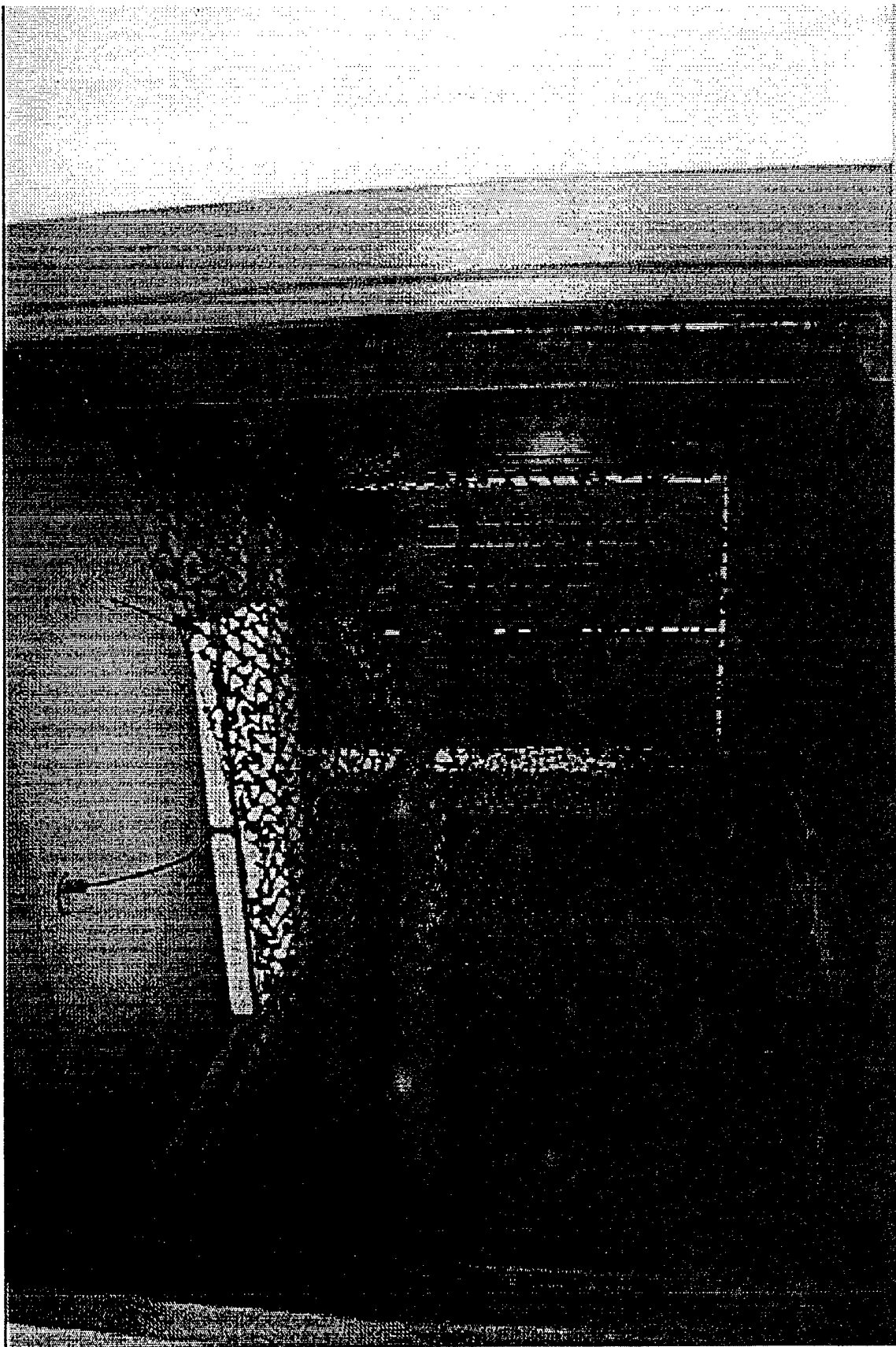
- 43 Building's
- 5 Family Housing Area Surveyed

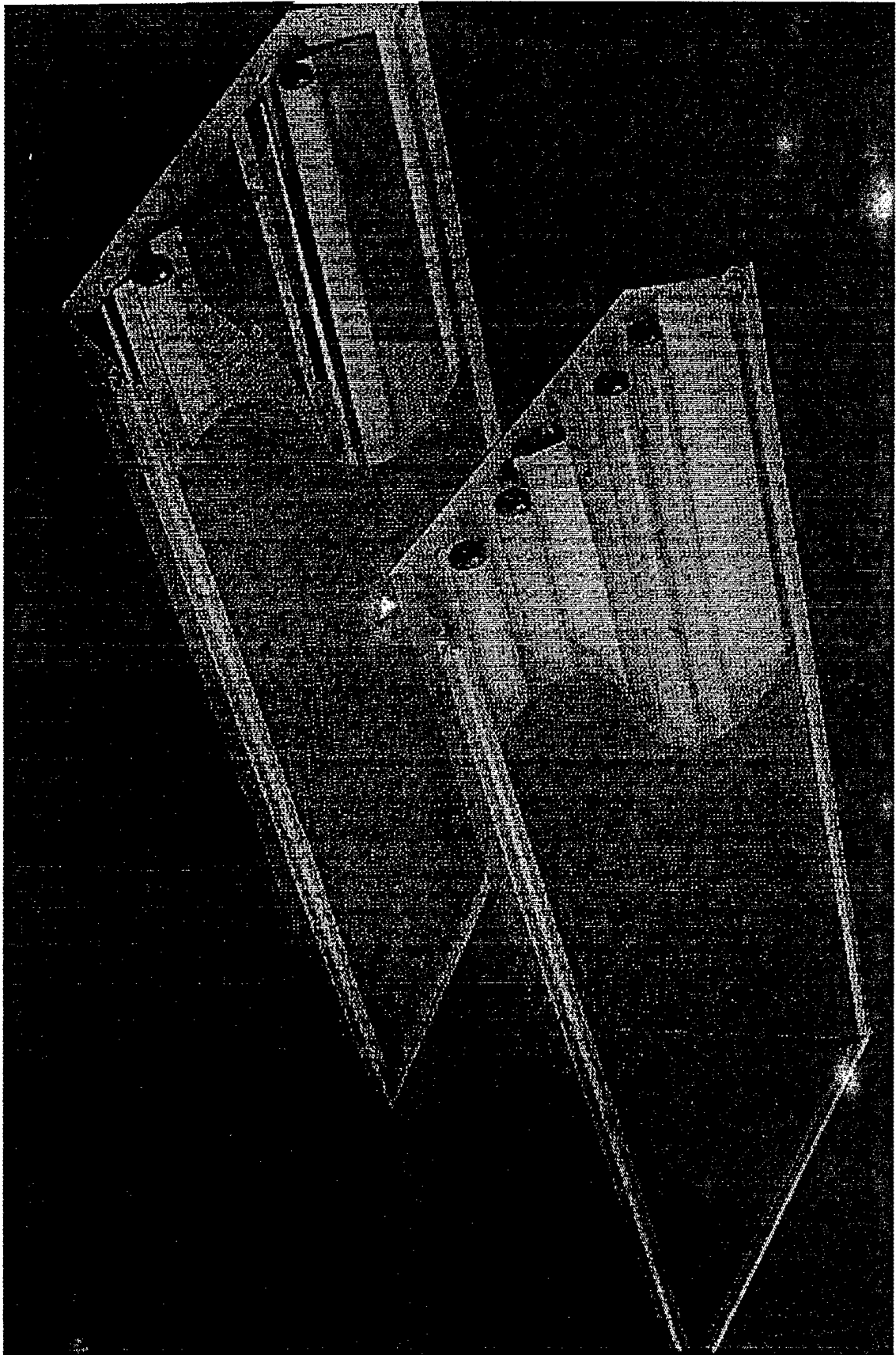
ECO-5: Information Collected

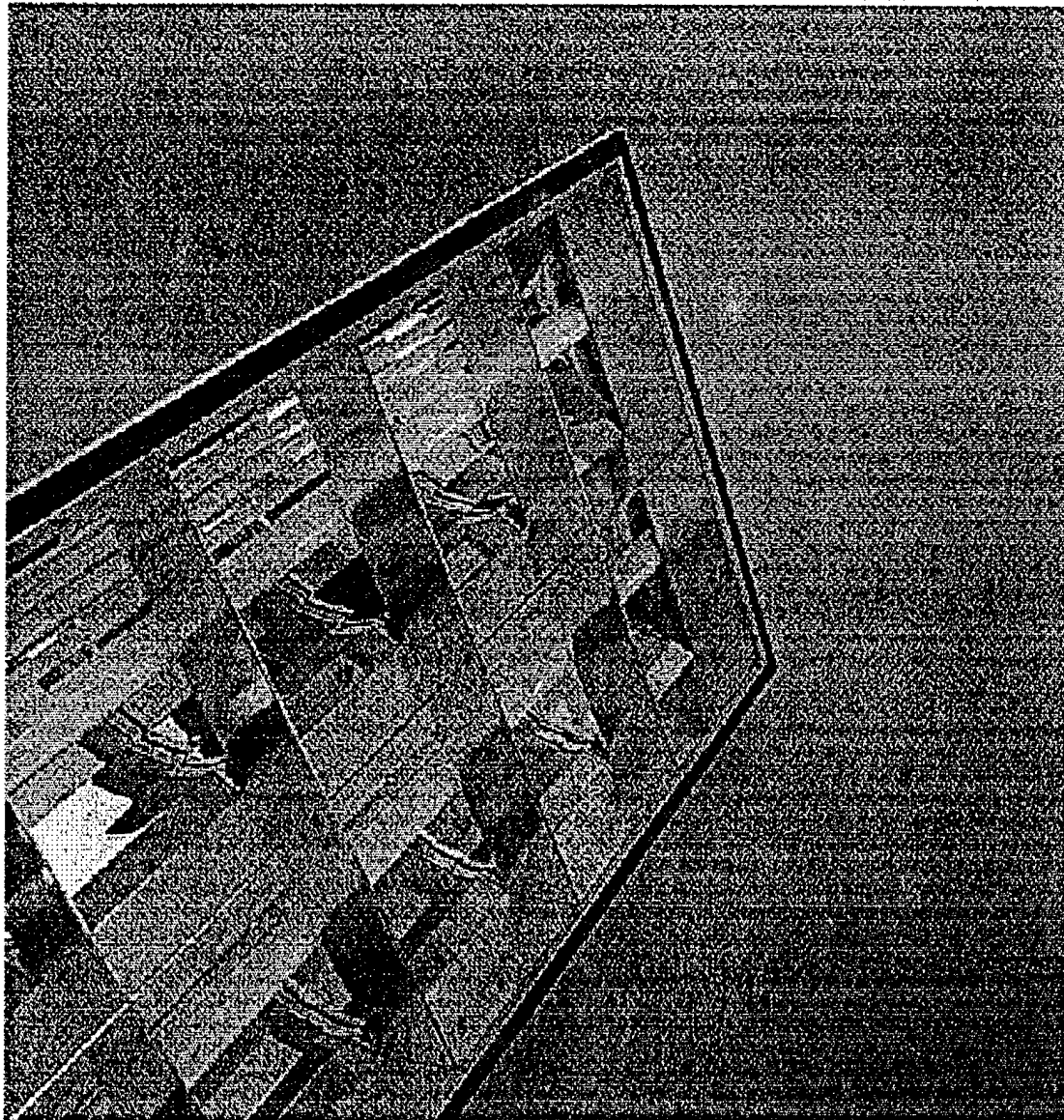
1. Building Hours of Use
2. Existing Fixture Type
3. Ballast Wattage
4. Lamp Wattage
5. Number of Fixtures
6. Applications for Occupancy Sensors

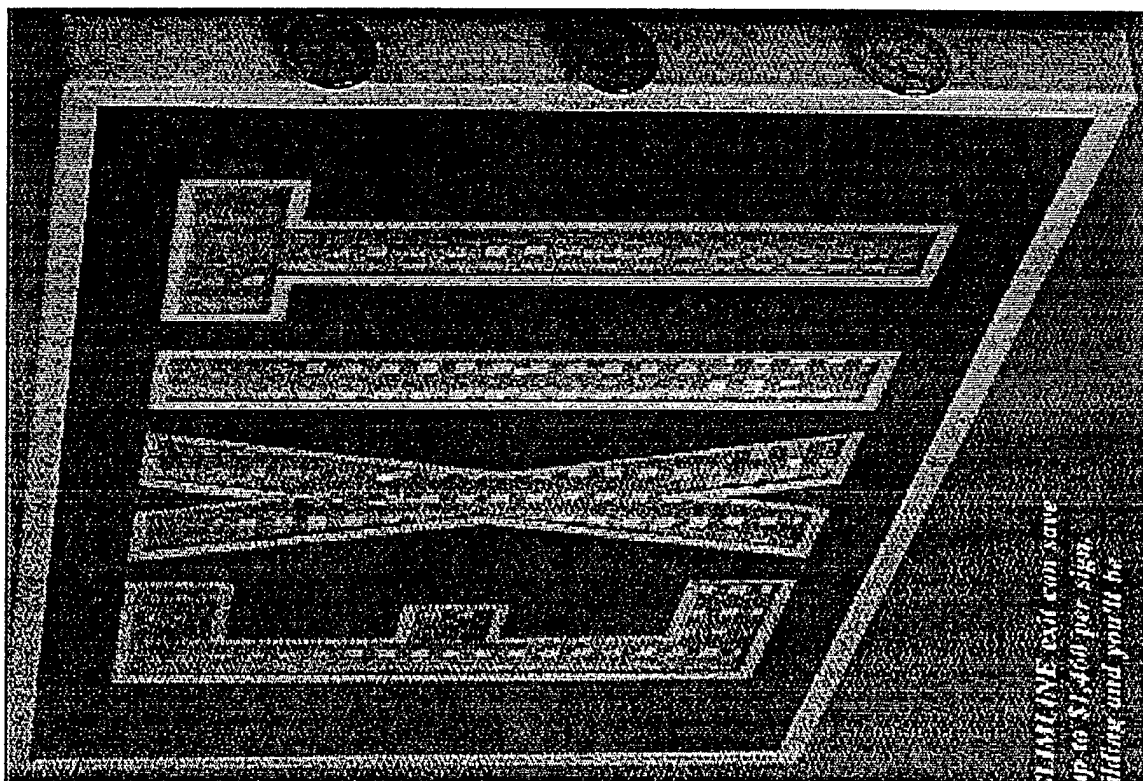




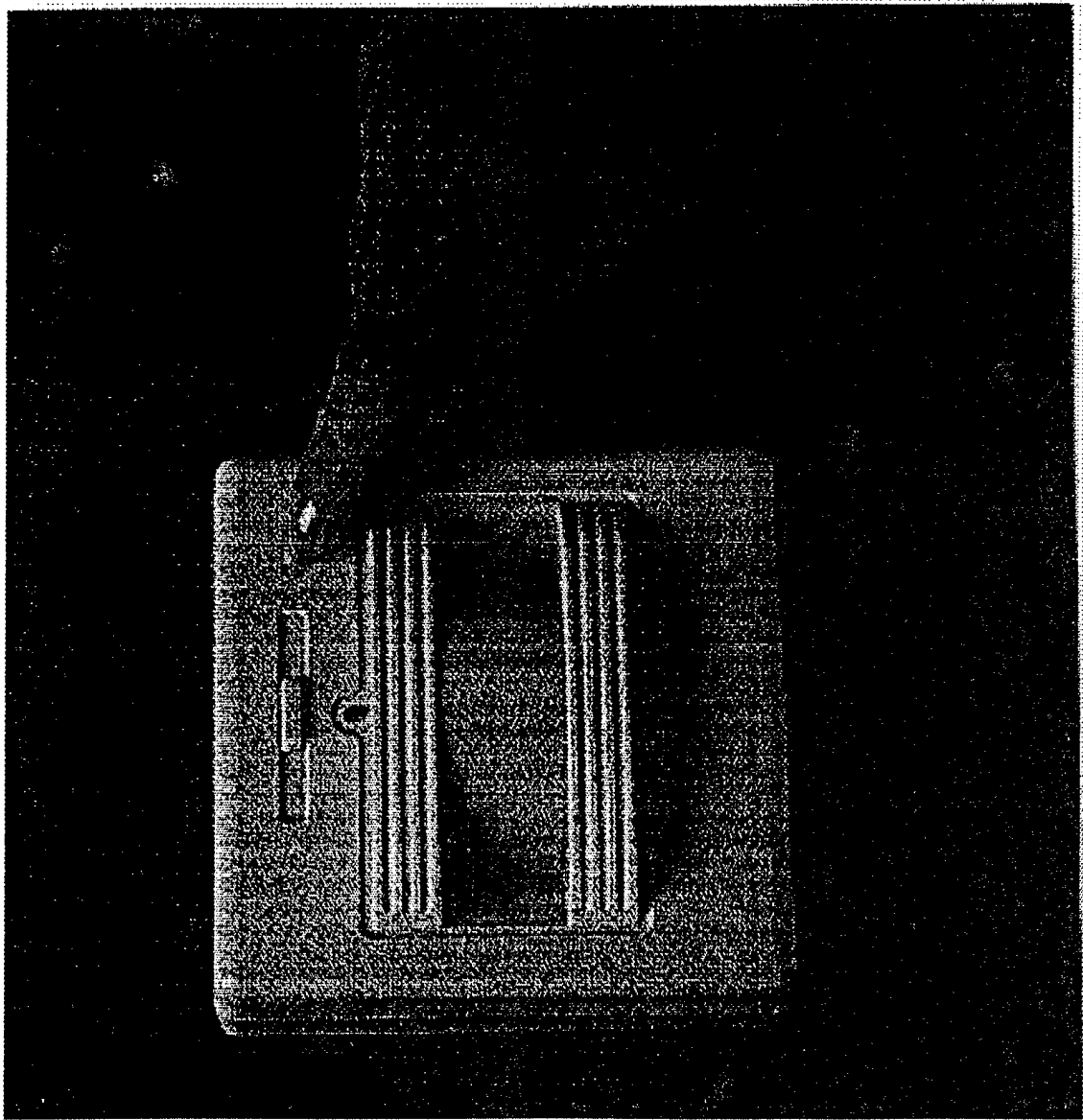








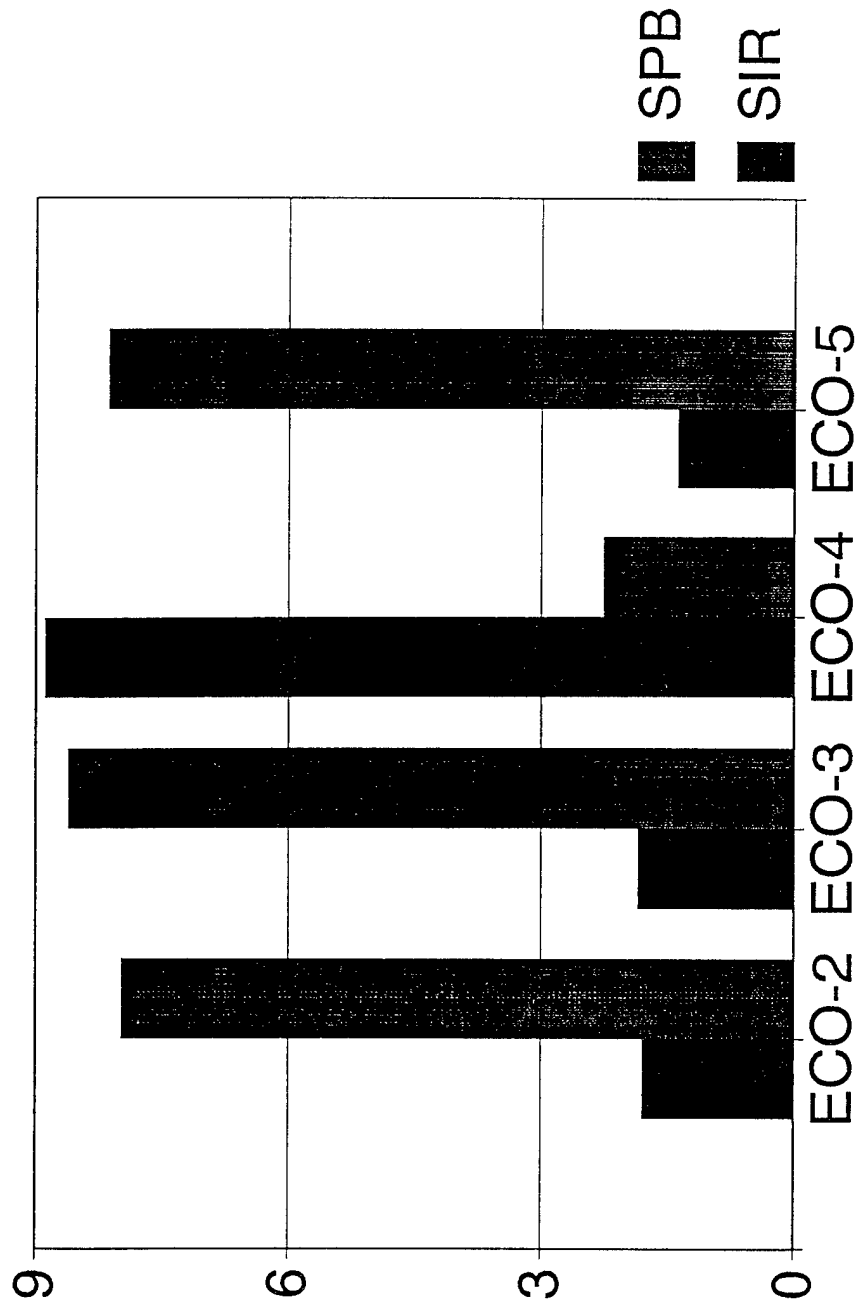
SLIMLINE exit can save
up to \$1,400 per sign.
Sliding and you'll be



ECO-5: Analysis Summary

Energy Savings	5,540 MBtu/yr
Cost Savings	\$90,401/yr
Investment	\$1,163,730
SIR	1.38
SPB	8.14 yrs

Fort Campbell ECO Comparison SIR and SPB



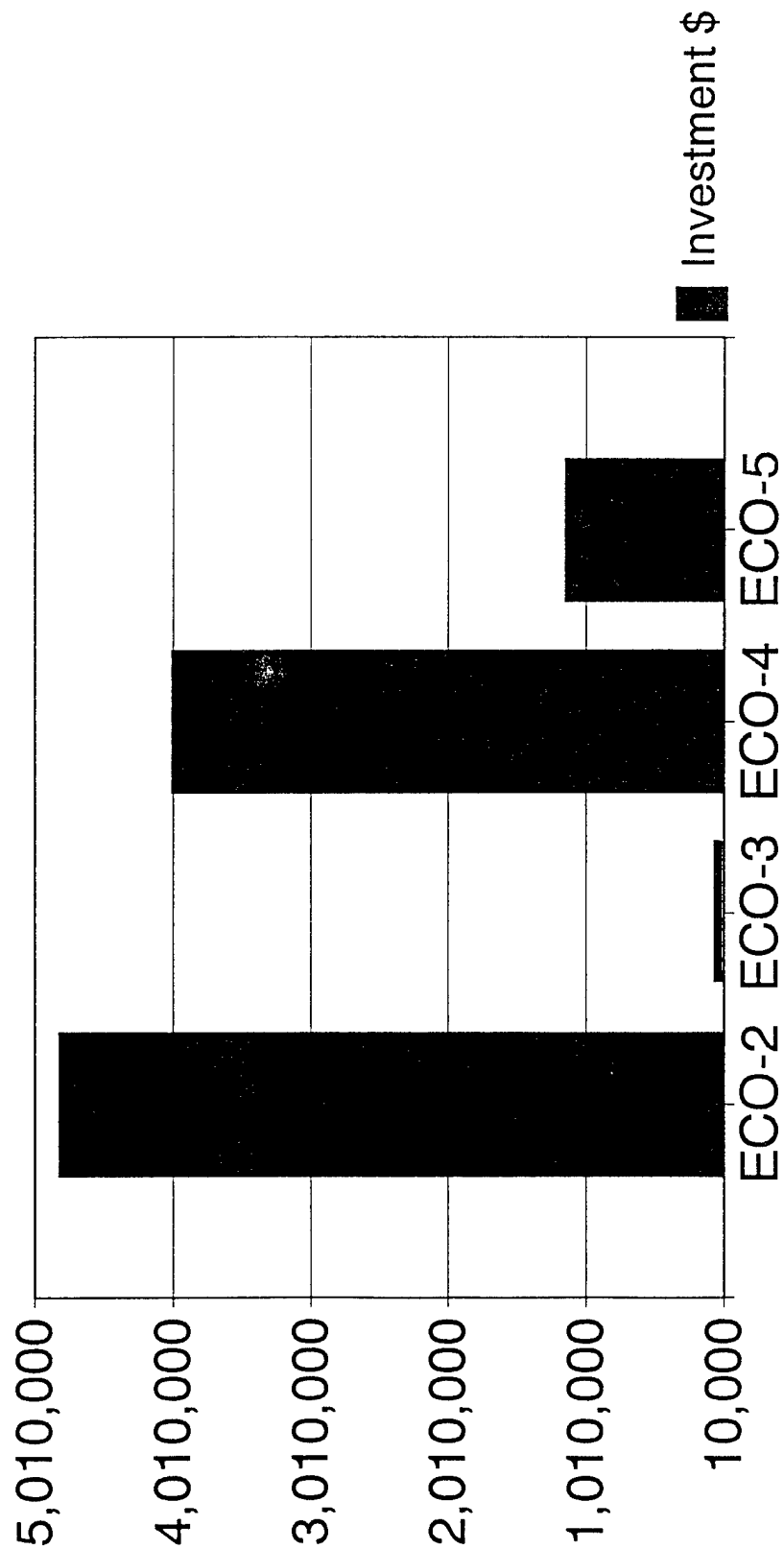
Fort Campbell ECO Comparison

Investment Costs

ECO-2	\$4,837,740
ECO-3	\$19,240
ECO-4	\$4,023,230
ECO-5	\$1,163,730

Fort Campbell ECO Comparison

Investment Costs



13 PRE-FINAL REVIEW MINUTES

PRE-FINAL REVIEW PHASE I AND PREFINAL REVIEW PHASE II MEETING MINUTES OCTOBER 22, 1993

ATTENDANCE LIST:

Charles Lockman	Louisville District CEORL-ED-MS	(502) 582-6041
Arlin E. Wright	Ft. Campbell DPW-MESB	(502) 798-8895
Gary Griffith	Ft. Campbell DPW-MESB	(502) 798-8895
Naresh Kapur	FORSCOM Engineer FCEN-PWO	(404) 669-6731
Keith Derrington	Systems Corp Project Manager	(615) 521-6536
Cheri Martin	Systems Corp Project Engineer	(615) 521-6536

The meeting was begun at 8:00 a.m. The initial part of the meeting was spent discussing the review comments for the Pre-Final report for Phase I and the Interim report for Phase II made by Naresh Kapur. Each of Mr. Kapur's comments were addressed and resolved. A list of Mr. Kapur's comments for both reports, along with Charles Lockman's comments for the Phase II report, are included as an attachment to the minutes. It was determined that the Pre-Final review meeting would be moved from November 15, 1993 to November 10, 1993.

The remainder of the meeting was a Systems Corp slide presentation summary of the results found, to date, for Phase I and II. The presentation for Phase II showed the results obtained for each specific ECO along with a discussion of the ECO survey, calculations, and economic analysis results. The presentation for Phase I displayed the results obtained for specific project groupings determined at a previous meeting.

The meeting was adjourned at approximately 11:00 a.m.

14.1 PHASE 1: COMMENTS

Naresh Kapur

VOLUME 1

Comment 1 General Based on experience with Phase 1 and Phase 2, please recommend what other buildings and what kinds of ECOs should be pursued to reduce energy consumption significantly. This can be a 1 to 2 page write-up.

Response: Will respond in a separate write-up.

Comment 2 Sect. 1.2.2 What is the purpose of this sub-paragraph? Maybe consider explaining sequence in which this report is organized.

Response: Will expand with description of each volume.

Comment 3 Fig. 1.3.1 & 1.3.2 Provide Units of Cost and MCF on Y-axis. Can the height of MCFs be comparable to cost?

Response: Will comply.

Comment 4 Table 1.3.2 Consider separating kwh cost and demand charges part in this table.

Response: Will comply.

Comment 5 Table 1.4.3 Provide overall figures for SIR and SPB.

Response: Will provide an average value.

14 PRE-FINAL REVIEW COMMENTS AND RESPONSES

Comment 6 Section 1 The economics of chiller project is different here than presented in interim review view graph at the end of this report. Explain.

Response: Buildings scheduled to be destroyed were removed from the project. This will be noted in the final report.

Comment 7 Section 2 Provide SF for Building 4601, Child Care Center.

Response: Arlin Wright will provide.

Comment 8 Section 2 Based on data collected on chillers, is it possible to replace existing chillers by two smaller units, for handling partial loads and provide better economics? Please discuss.

Response: Withdrawn.

Comment 9 Section 2 Add titles following ECO number wherever needed.

Response: Will comply.

Comment 10 Section 2 Explain different replacement options in detail - in layman's language.

Response: Will comply.

Comment 11 Section 4 What part of the constuction cost is used in replacement cost (3B). Also provide PB and AIRR figures. Similar situations exist for other ECIPs.

Response: The report will be revised to explain the replacement cost at the front of the programming document.

14 PRE-FINAL REVIEW COMMENTS AND RESPONSES

Comment 12 Section 1 Scope of work can be in more detail explaining existing conditions, final conditions, special situations, and different treatment for different areas for FC requirement point of view.

Response: Withdrawn.

VOLUME 2

Comment 13 Section 4 Do we have LCCA for each building where lighting ECOs are considered? If so, where do we look?

Response: These are included in the Interim Report.

VOLUME 3

Comment 14 Section 5 For all ECIP front pages, use ECIP guidance and round off dollar figures accordingly.

Response: Will comply.

Comment 15 Section 5 How to verify figures used in 3A and 3B of LCCA? Add PB and AIRR figures wherever missing for Special Requirement, Paragraph 1.

Response: Refer to comment 11.

Comment 16 Section 7 Last sentence "please refer to section 4 for detailed description of the ECO". Please provide a real detailed description we can give NAF folks with the analysis for their further action.

Response: Will comply.

14.2 PHASE 2: COMMENTS

Naresh Kapur

VOLUME 1-6

Comment 1 General

This interim submittal is well documented. In next submittal, mention how many buildings and total SF is covered by this study (Phase 1 and Phase 2). What areas, especially large facilities, are not covered? This can be part of the Executive Summary write-up.

Response:

Will include as separate write-up.

VOLUME 1

Comment 2 Section 2

Add titles following ECO numbers.

Response:

Will comply.

Comment 3 Section 3.1.1

Paragraph 3, cross reference as to where expanded description of each ECO can be found. An ECO like #3, Indoor/Outdoor Lighting has many variations. Each need to be described in simple language. Provide catalog type information wherever possible.

Response:

Will comply in Pre-Final report.

VOLUME 1-2

14 PRE-FINAL REVIEW COMMENTS AND RESPONSES

Comment 4 Section 5 Under "Project Notes" for ECO-6, Building 6734, it would be very helpful to document what is the current situation and what is being done as part of this ECO. Just repeating generic scope of work each time is not acceptable. This comment applies to other buildings under this ECO and other ECOs also.

Response: Withdrawn. Covered in spreadsheets.

Comment 6 Section 5 Page 5-215, Project Number 006-6904, credit is not applied for future cost avoidance (Item 3B of LCCA). The credit is applied for many similar ECOs but not all. Please explain.

Response: Will explain in Pre-Final report.

VOLUME 2

Comment 5 Section 5 Please explain each item of the cost estimate. Do the fixtures come assembled, ready to be installed? If not, investigate the possibilities labor saving can be significant. This is applicable to similar ECOs in other buildings.

Response: Will explain on page 5-1.

Comment 7 Section 5 In 3B, the replacement cost of \$5,783 is about the same as in 1D for Project Number 006-SP. For Project Number 006-7856, the replacement cost of \$23,309 in 3B is different from \$29,141 in 1D. Please explain how these figures are picked up. This situation may be applicable to other ECOs also. Please check.

Response: Will explain

VOLUME 3

Comment 8 Section 6 Elaborate the Scope of Work in sufficient details as to how this ECO works. Spell out the work involved and any change of current operation. Is there any requirement of additional maintenance and repairs? Provide sketches, etc., as needed.

Response: Withdrawn.

Comment 9 Section 7 Have we considered gas operated chillers. If we did, let us talk about it.

Response: Will explain in Pre-Final.

Comment 10 Section 8 Can we consider non-energy saving in 3B, future replacement cost of existing motors? We have done it for lighting ECOs, is this a different situation?

Response: Will explain in Pre-Final.

Comment 11 Section 9 For each ECO, elaborate the Scope of Work. Add sketches as needed. What EMCS will accomplish in each building? What kind of system is considered? Is it DDC or other type. Will this accomplish all the EMCS expansion needed? Try to present an overall EMCS picture as a part of background to the Scope of Work.

Response: Will add explanation.

VOLUME 4

Comment 12 Section 10 Describe Scope of Work in more detail. Discuss current light level and anticipated light level in different areas. We need to provide details to commissary organization for further action. The ECO analysis look good.

Response: Will explain on page 7-1.

Comment 13 Section 11 Delete D Project Non-energy qualification test. Add an item for Payback years.

Response: Withdrawn.

VOLUME 5

Comment 14 Section 15 Please explain how overlit areas have been dealt with. Is delamping some fixtures considered/suggested? Is lower light level needs in corridor areas and toilets recognized in ECOs? (Example: Buildings 6901, 6908, and 6907.)

Response: Refer to Section 5-1, Interim report.

14 PRE-FINAL REVIEW COMMENTS AND RESPONSES

Charles Lockman

VOLUME 4

Comment 1 Section 11

ECO-7: Peak-Shaving Generators took the place of Waste Heat Recovery-Heat Exchangers. Because this is the Narrative Summary, should we have either noted a change here, or ink change the SOW changed as result of, etc.? (This is to help others later looking at reports)

Response:

Will note the change.

Comment 2 Section 11

11.3.6 ECO-11: Commissary Lighting (same as Comment 1). This ECO was added/picked up as result of ECO #7 not up front have good positive results. This ECO and ECO 7 were studied. Again, this is for summary consideration.

Response:

Will note the change.

ENERGY SAVINGS OPPORTUNITY SURVEY

Fort Campbell, Kentucky

Phase I - Prefinal Review

REMAINING PHASES

- Response to Prefinal Review Comments
- Final Report

WORK ACCOMPLISHED TO DATE

1. Field Surveys Completed for 99 Buildings
2. Exterior Lighting Surveys for 5 FH Areas
3. Baseline Energy Models
4. Evaluation of 142 Energy Conservation Opportunities
5. Calculations and Reporting of Solid Energy Conservation Opportunities for Possible Implementation
6. Preparation and Completion of all Field Notes
7. Completion of Interim Reports

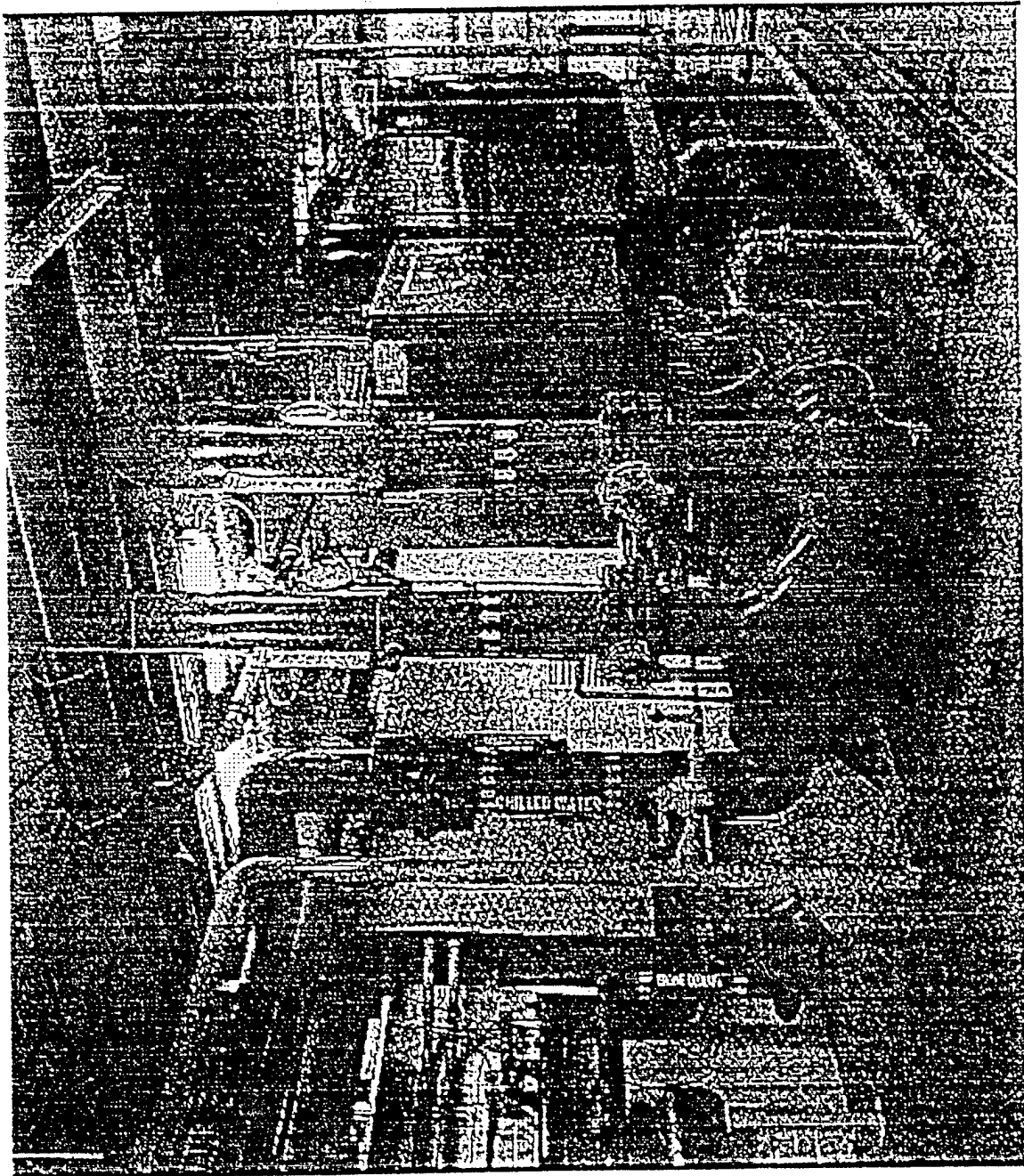
PROJECTS

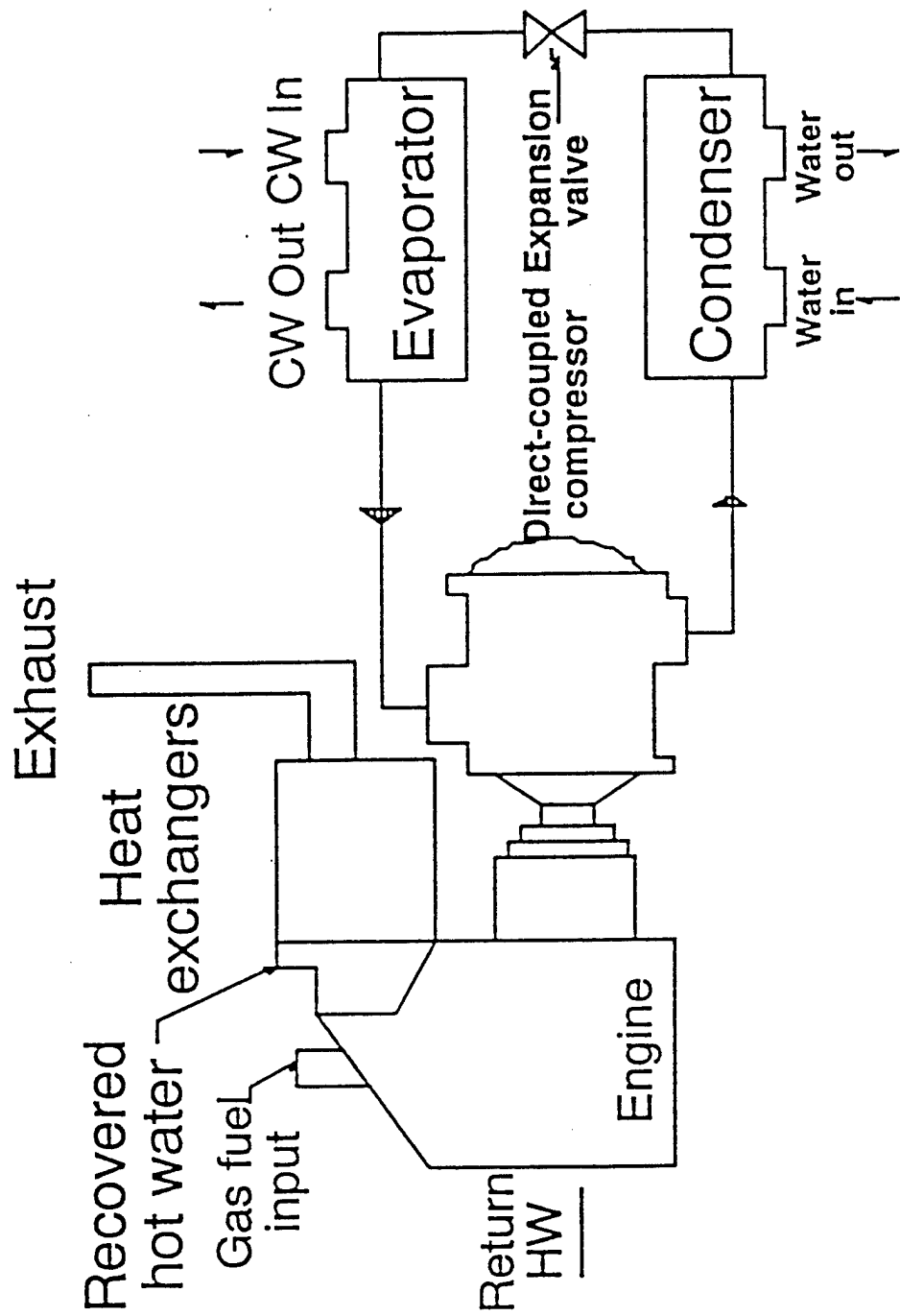
1. Absorption Chillers
2. Lighting
3. Ground Water Coupled Heat Pumps
- *4. Heat Reclaim at Commissary
- *5. NAF Lighting

* Programming documents not prepared for these projects

PROJECT 1: Replace Absorption Chillers

Energy Savings	301,490 MBtu/yr
1st Year Savings	\$1,336,609/yr
Investment Costs	\$4,115,522
SIR	6.87
SPB	2.92 yrs

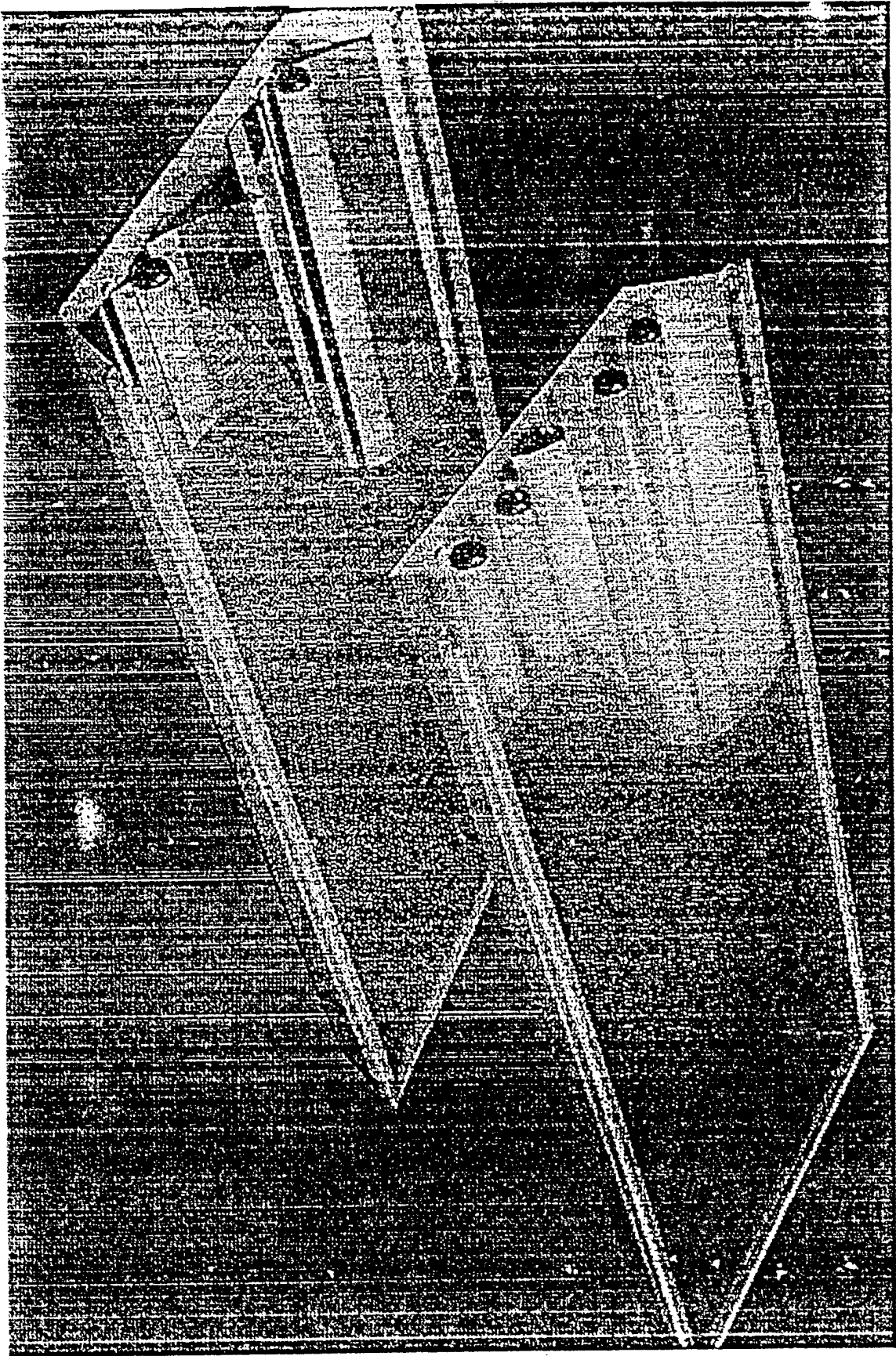


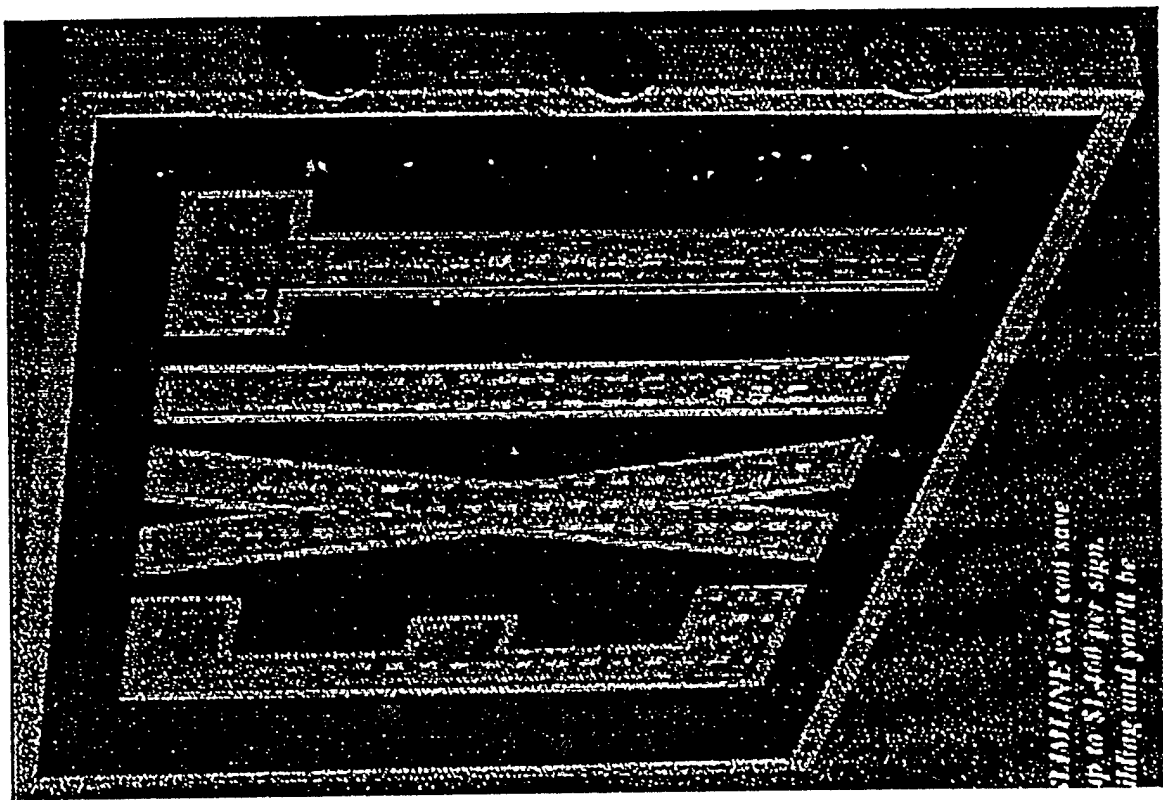


Gas Engine Driven Chiller

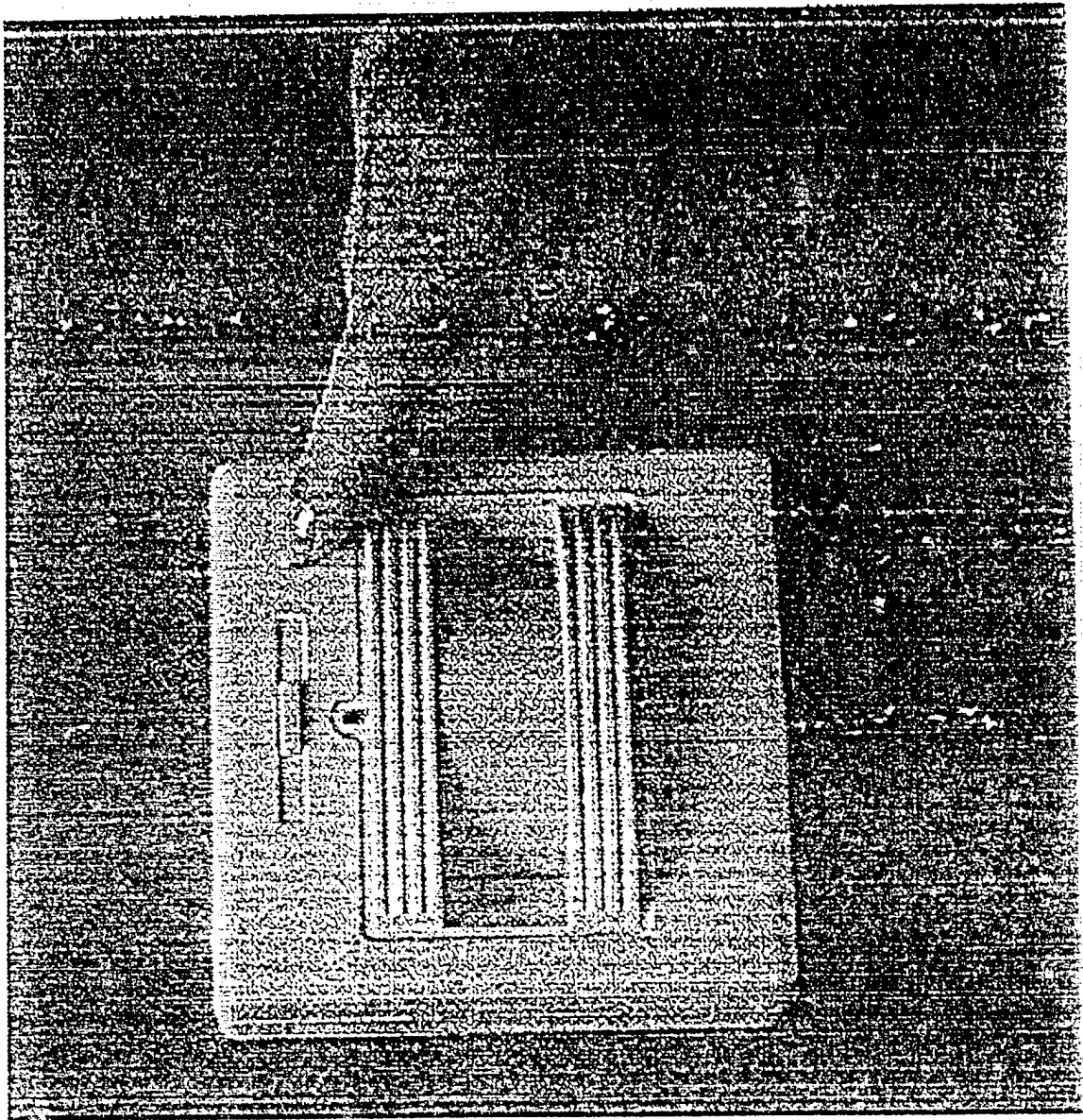
PROJECT 2: Indoor/Outdoor Lighting

Energy Savings	5,725 MBtu/yr
1st Year Savings	\$142,057/yr
Investment Costs	\$1,073,612
SIR	1.48
SPB	7.56 yrs



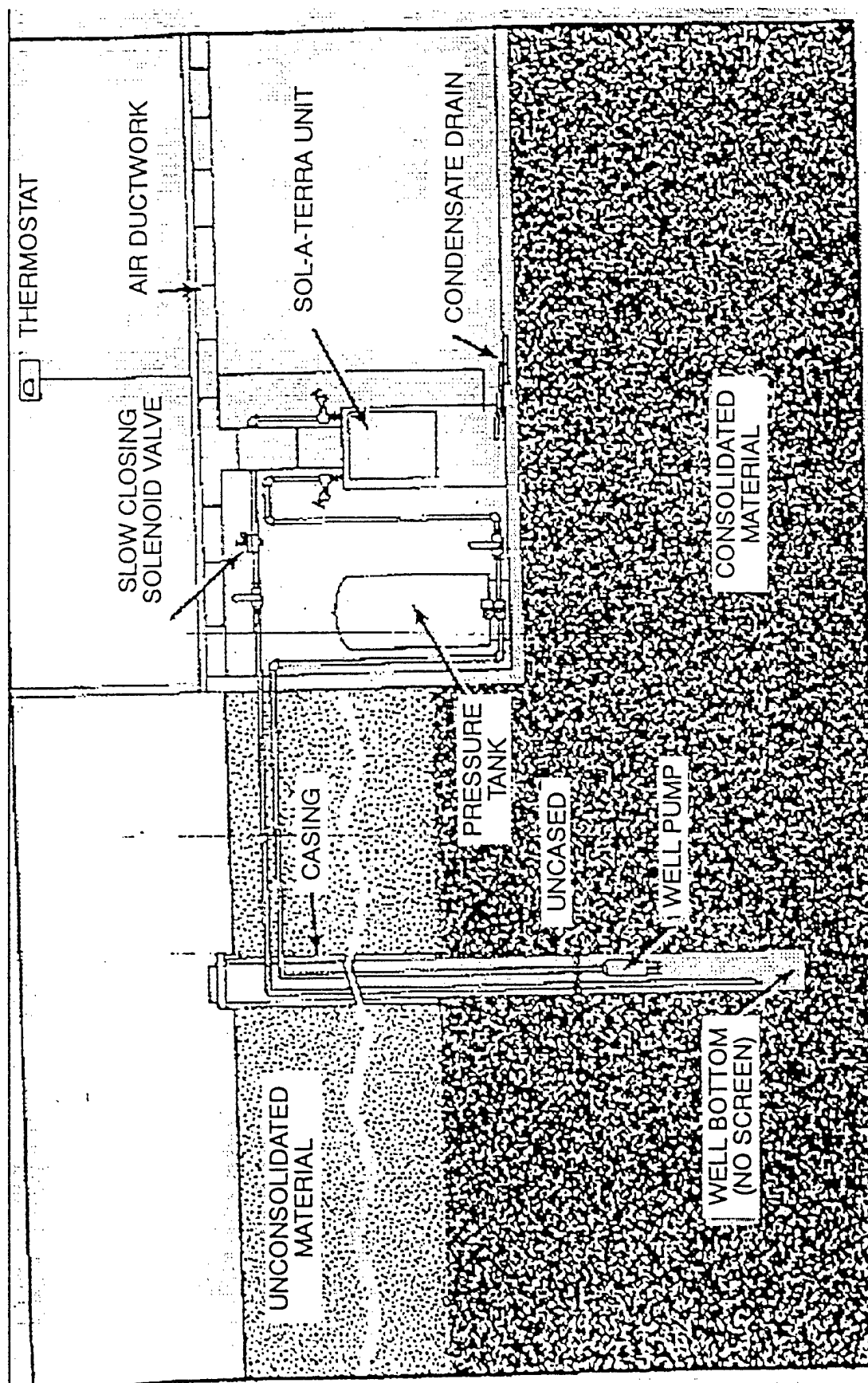


EXIT 150 exit cost save
up to \$1.400 per sign
holding and you'll be



PROJECT 3: Ground Water Coupled Heat Pumps

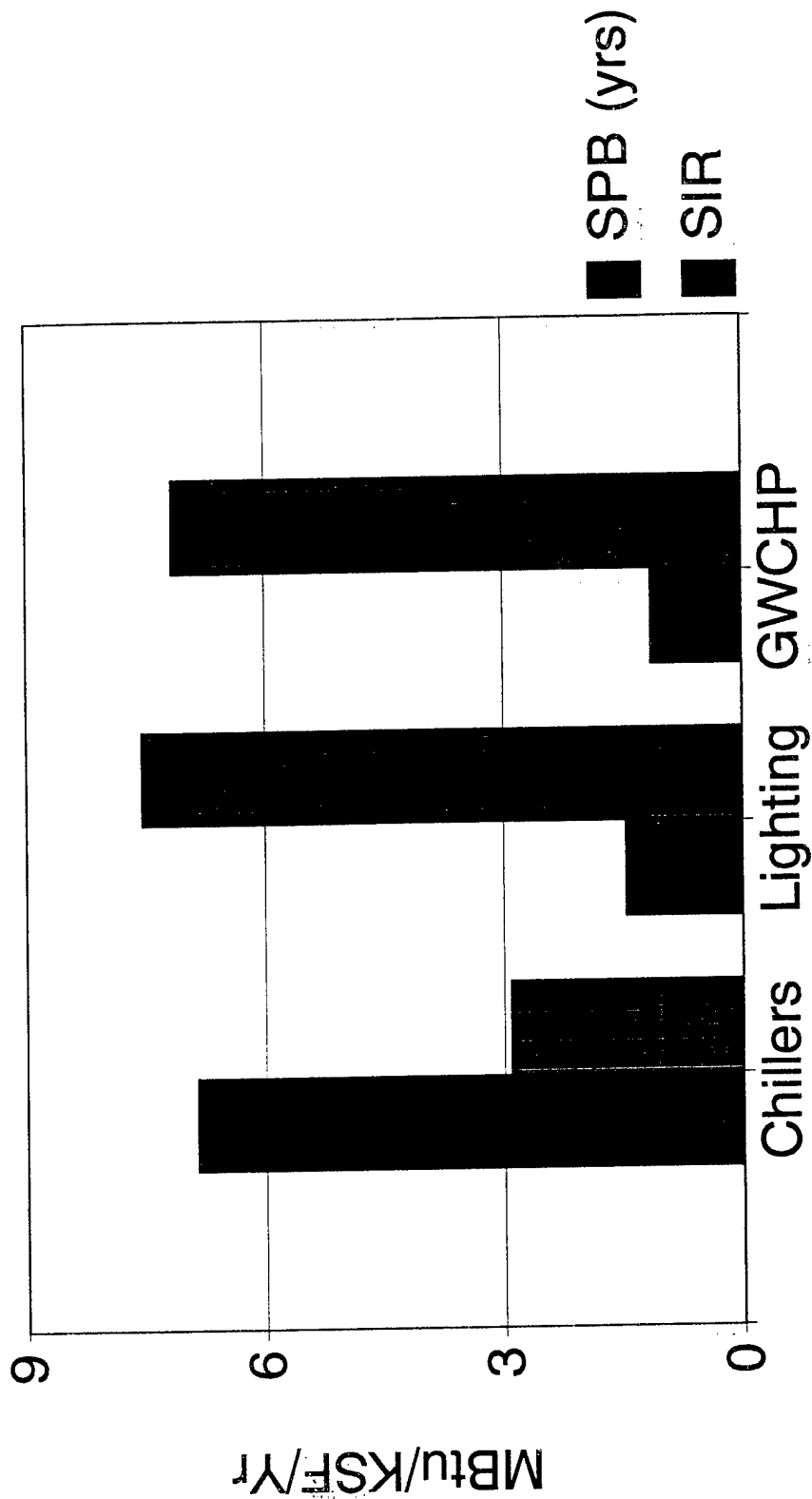
Energy Savings	39,544 MBtu/yr
1st Year Savings	\$674,606/yr
Investment Costs	\$4,837,740
SIR	1.15
SPB	7.17 yrs



PROJECT SUMMARY

	<i>1st yr Savings</i>	<i>Investment</i>	<i>SIR</i>	<i>SPB (yrs)</i>
Chillers	\$1,336,609	\$4,115,522	6.87	2.92
Lighting	\$142,057	\$1,073,612	1.48	7.56
GWCHP	\$674,606	\$4,837,740	1.15	7.17
TOTAL	\$2,153,272	\$10,026,874		

PROJECT COMPARISON SIR and SPB



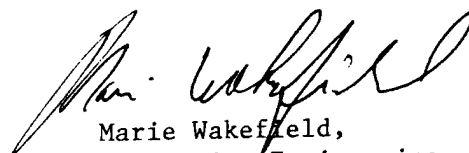


DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
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